REPORT OF THE
DEPARTMENT OF
WASTE MANAGEMENT

The Feasibility of a Statewide Yardwaste Composting Program for Virginia

TO THE GOVERNOR AND
THE GENERAL ASSEMBLY OF VIRGINIA

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Report of the
Department of Waste Management
on the Study of Composted Yard Wastes
Requested by House Joint Resolution Number 395 (1989)
To
The Governor and the General Assembly of Virginia
Richmond, Virginia
January, 1990

TO: The Honorable Gerald L. Baliles, Governor of Virginia
and
The General Assembly of Virginia

FOREWORD

The 1989 General Assembly adopted HJR 395, which requested the Department of Waste Management to conduct a study of the feasibility of a statewide composting program for leaves and other yard wastes.

HJR 395 requested the Department to:

1. work in cooperation with and secure the participation of the Virginia Department of Agriculture and Consumer Services, and the Cooperative Extension Services of Virginia Polytechnic Institute and State University and Virginia State University.

2. study the amount of yard waste material available, the potential reduction of such material from the waste stream, the current and future uses for the end product, the techniques for the production of yard waste compost, the economic impacts and benefits to the Commonwealth, and the level of participation of the private sector.

3. develop recommendations for implementation of a statewide program.

An advisory committee of representatives from the agencies referenced in HJR 395 was formed in May, 1989. The committee recommended that the Department of Waste Management accept a proposal from the College of Agriculture and Life Sciences at Virginia Polytechnic Institute and State University, and the Virginia Cooperative Extension Service, to conduct the feasibility study. The Department of Waste Management approved the committee's recommendation and in June, 1989, a contract was entered into between the Department and Virginia Polytechnic Institute and State University.

The Department of Waste Management requested that the scope of the study proposal be expanded to include a major emphasis on the markets for composted yard waste and that potential users be identified.

The research study began on July 1, 1989 and was concluded on December 1, 1989. A final report describing the study's findings and recommendations was presented to the Department and the other referenced agencies on December 7, 1989.

The final report, "The Feasibility Of A Statewide Yardwaste Composting Program For Virginia", has been reproduced in its entirety for this document, and begins on the following page. The recommendations for the Department of Waste Management and the General Assembly are listed in the Executive Summary section of the report and are explained in detail, beginning on page 39.

The Department has begun coordination of the administrative and regulatory changes recommended by the study, so that composting as a waste management technique may be more widely employed.

The Feasibility of A Statewide

Yardwaste Composting Program for Virginia

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Submitted to
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EXECUTIVE SUMMARY

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This study was conducted to determine the feasibility of developing and implementing a statewide program for composting yardwaste (leaves and grass clippings). The study was conducted by the Virginia Cooperative Extension Service for the Virginia Department of Waste Management as directed by the 1989 Session of the General Assembly pursuant to House Joint Resolution No. 395.

Currently, most yardwastes are disposed in landfills, although that practice is being reduced rapidly throughout the nation. There is a serious national crisis concerning solid waste management and the availability and cost of landfill space. As a result, local, state and federal governments are focusing attention on means of reducing municipal solid waste (MSW) volumes requiring landfilling. It is apparent in Virginia and throughout the country that yardwaste may be a key MSW component in achieving substantial source reduction/recycling in a short time period. Typically, yardwaste is thought to comprise 15 to 20% of the MSW volume but ranges from 5 to 40%.

However, diverting yardwaste from landfills requires alternative processing (composting) and the development of uses and markets for the finished products. As a result, a major focus of this study was to evaluate the potential market for composted yardwaste, identify potential user groups and estimate the volume that could be marketed. Additional emphasis was placed on the amount of material, the suitability of yardwaste components for composting, potential reductions in MSW volumes, appropriate technologies for yardwaste composting and their costs, cost savings and the role of the private sector. A secondary focus was on the potential for removing woody waste from the waste stream. While conducting the study, it also became evident that methods to change public perception/behavior concerning the need to collect yardwaste, particularly grass clippings, should be evaluated.

METHODS

A computerized literature search conducted at Virginia Tech, identified several hundred articles, journals, manuals and books in print on the subject of composting. A complete listing of all articles, journals, books and manuals used in compiling information can be found at the end of the report.

Ten composting sites around the country were visited during the study and telephone interviews were conducted with regulators, consultants and facility operators at other locations. Three surveys were developed to determine the amount of compostable yardwaste potentially available, the perceived markets for compost and interest in composting and compost utilization. Virginia Nursery Operators, Solid Waste Management Permit Holders and Extension Agents-Agriculture were surveyed. Each survey was designed to match the area of expertise of the individual group.

Results and Recommendations-Yardwaste

The first concern for any composting program is the appropriateness of available technology. The most appropriate technology is a function of the material, available land area, nuisance potential, equipment availability, available resources, potential environmental harm and regulatory requirements. Strom and Finstein (1986) classified yardwaste composting procedures into four levels of technology based on equipment and resource requirements, composting time, land area requirement and quality of the finished product. These four levels are minimal, low, intermediate and high technologies. Based on this study, the low level of technology is best suited for small to medium localities and intermediate technology is most appropriate for medium to high population areas.

Survey results indicated that at least 83% and 81% of the solid waste managers surveyed landfilled their leaves and grass clippings, respectively. If a conservative average of 15% yardwaste is used with an approximate total MSW volume of 6.5 million tons per year, then about one million tons or four million cubic yards of yardwaste are collected in Virginia each year with the vast majority going to landfills. The average landfill tippage fee for survey respondents was $19.63/ton. These fees should rise rapidly in the near future. Based on projected yardwaste volumes and the average tippage fee, landfill space valued at almost twenty million dollars is being used for yardwaste.

It is estimated that, if all yardwaste in Virginia were composted, 800,000 cubic yards of finished compost would be generated each year. However, efforts will be made to reduce grass clipping removal and increase backyard composting. This should result in an annual compost volume of less than 600,000 cubic yards per year. Current demand for similar materials (peat moss, organic materials in potting mixes, etc) could account for about two thirds of that volume. Through public education, increased public sector use and other recommended programs, it is estimated that markets can be developed for all yardwaste compost. Municipalities should also encourage backyard composting as a part of their overall yardwaste management program. Participation in backyard composting will depend in part on the public's understanding of the cost and problems associated with landfilling or otherwise disposing of yardwastes.

It is apparent that yardwaste can be composted at a cost less than the current state average tippage fee ($19.63/ton). Thus, statewide composting of yardwaste is feasible and should result in substantial savings for localities. It is therefore recommended that the state prohibit the placement of leaves and grass clippings in landfills after January 1, 1995. To accomplish this goal, changes must be made in the Solid Waste Management Regulations to facilitate siting and operation of yardwaste compost facilities. Some localities may need assistance from the Virginia Resource Authority to assist with capital costs. However, there is a great deal of private sector interest in composting at rates below landfill tippage fees which could reduce capital outlay burdens on localities. To provide incentive for private composting facilities, it is recommended that low interest loans and/or tax incentives be provided for establishment of such facilities.

For the program to succeed, the technologies must be understood by state and local government and private personnel, the demand for yardwaste compost must increase and the volume of yardwaste collected (particularly grass clippings) must decrease. To increase understanding of technologies and use volume, six pilot projects

with an associated public education program should be conducted. Public education on backyard composting is needed as is an educational program to reduce the removal of grass clippings.

Local governments should also be encouraged to restrict the collection of grass clippings. Finally, the Governor should issue an executive order requiring state agencies to use or have their contractors use composted yardwaste in place of comparable organic materials when available at a competitive price and an acceptable quality. This order should become effective January 1, 1991. In addition, local governments should be encouraged to require local agencies to use compost generated within that locality when appropriate.

If the recommendations of this report are implemented, the goal of removing yardwaste from landfills by 1995 can be accomplished. This will result in recycling of 15-20% of the total municipal solid waste volume in Virginia.

Results and Recommendations-Woody Waste

It is estimated that woody waste comprises 15 to 20% of the municipal solid waste volume. Disposal of woody wastes currently consists of landfilling or burning. Since woody materials decompose very slowly, composting is impractical in most cases. However, this material can be reduced in size and used in soil mixes, as mulch or as Resource Derived Fuel (RDF). Other potential uses would be for processed wood products, such as particle board or as pulp.

Virginia does not currently have a good market for RDF so the major potential use of woody waste would be mulch. However, the demand for mulch is currently filled through the use of various waste wood by-products such as shredded bark. It also appears that the total demand for mulch materials is than half the volume potentially available.

Based on this study, it is not currently feasible to recycle all woody waste. However, given the large volume of materials, the state should support programs that will lead to recycling of the material. Alternative uses of woody waste must be developed if these materials are to be recycled. Woody waste are generally not considered suitable for use in pulping or manufactured wood products (pressboard, fiberboard, etc.) because of foreign materials (soil, rocks, etc). Additional research is needed to determine the feasibility of making woody waste suitable for these uses or developing other innovative beneficial uses.

It is recommended that a state of the art project be conducted to determine technologic constraints on uses of woody waste and to determine research needs. Based on the results of this project, research should be conducted to develop technologies that allow the use of woody waste in manufactured wood products or pulp. The potential future RDF market for woody waste should also be determined. An ongoing private sector pilot program on the controlled long term decomposition of woody waste for use as a soil amendment should also be evaluated for potential applicability.

INTRODUCTION

This study was conducted to determine the feasibility of developing and implementing a statewide program for composting yardwaste (leaves and grass clippings). The study was conducted by the Virginia Cooperative Extension Service (VCES) for the Virginia Department of Waste Management (DWM) as directed by the 1989 Session of the General Assembly pursuant to House Joint Resolution No. 395.

The interest in yardwaste composting in Virginia was found to be representative of intense and rapidly growing interest in the subject throughout the nation. Currently, most yardwastes are disposed in landfills although that practice is being reduced rapidly throughout the nation. There is a serious national crisis concerning solid waste management and the availability and cost of landfill space. As a result, local, state and federal governments are focusing attention on means of reducing municipal solid waste (MSW) volumes requiring landfilling. Mandatory recycling levels for MSW are in place at the federal level and many states have set recycling goals more ambitious than federal requirements. In Virginia, landfills must be recycling 10% of their waste volume by 1991, 15% by 1993 and 25% by 1995.

It is apparent in Virginia and throughout the country that yardwaste may be a key MSW component in achieving substantial source reduction/recycling in a short time period. Typically, yardwaste is thought to comprise 10 to 30% of the MSW volume. Thus, at a minimum, composting/recycling of yardwastes would allow localities to meet the 1991 recycling goal and some localities could meet the 1995 goal solely by removing yardwaste from their landfills. Obviously, yardwaste should not be the sole focus of a local recycling program but it may offer a rapidly achievable and substantial reduction in MSW volume.

However, removing yardwaste from landfills requires alternative processing (composting) and the development of uses/markets for the finished products. Thus, this study focused on the amount of material available, the suitability of yardwaste components for composting, potential reductions in MSW volumes, appropriate technologies for yardwaste composting and their costs, cost savings, the role of the private sector, and potential uses/users of yardwaste compost. A secondary focus was on the potential for removing woody waste from the waste stream.

While conducting the study, it become evident that methods to change public perception/behavior concerning the need to collect yardwaste, particularly grass clippings, should be evaluated. Based on information gathered, programs needed to encourage yardwaste composting, to increase compost use, to involve the private sector, and to change public perception/behavior were identified. In addition, further information needs and possible alternative management for woody waste were identified.

Composting As A Waste Management Alternative

Composting has been used as a means of converting organic wastes into a useful material for thousands of years. Composting was originally done to generate a beneficial soil amendment without an emphasis on waste management. However, during the last

thirty years it has been recognized that composting can serve as a means of recycling many types of wastes.

The initial emphasis on the use of composting technologies as a waste management alternative was focused primarily on sewage sludge. During the 1960's and 1970's, a great deal of research was conducted on technologies for composting sewage sludge. This research provides the basis for the technologies applied to yardwaste composting.

Since the early sludge composting research, almost all types of organic waste have been evaluated for their suitability for composting. Animal, food processing, pharmaceutical, petroleum, pulping, textile and other wastes have all been composted with some degree of success. In addition, efforts have been made to compost organic portions of municipal solid waste. Although some MSW composting facilities are operational, the inability to remove glass, plastic and some metal has limited the applicability of this technology. Compost produced from MSW often contains small pieces of glass and metal that prevent it from being distributed and used. It appears that improved segregation of MSW before collection or at a centralized post collection site will be necessary before MSW composting can become a standard practice. The city of Portland, Oregon has just let a contract that requires post collection segregation followed by composting of the organic MSW fraction. This appears to be the first large scale MSW composting operation established under a long term contract. The performance of the Portland program should be closely followed.

Some yardwaste composting has occurred for many years. However, the current focus began in the mid 1980's with work conducted by Strom and Finstein (1986) at Rutgers University. During the last five years, efforts have been made to adapt composting technologies to best handle yardwaste. This work will be discussed in more detail later in this report.

The Composting Process

Composting is the manipulation of the natural aerobic (oxygen demanding) process of decomposition of organic materials to increase the rate of decomposition. The processes are very similar to the decomposition of leaves that fall in the forest but occur at an accelerated rate. When leaves first fall, they remain on the surface for extended periods but slowly begin to decompose due to fungal and bacterial activity. If you look at a leaf mat in a forest you can observe leaves in varying states of decay going from fresh leaves on the surface with progressing decomposition as you near the mineral soil surface. Directly above the mineral soil surface is a rich, dark layer of stable organic matter or humus. This material consists primarily of decomposed leaves and fungal and bacterial cell mass. Leaf or yardwaste compost is very similar to that stable organic matter. Composting accelerates the decomposition process by controlling temperature and moisture and assuring that an adequate supply of oxygen is present. The technologies used to control these environmental factors will be discussed in more detail later.

METHODS

Literature Review

A computerized literature search was done at Virginia Tech, utilizing information available from the National Agricultural Library in Beltsville, Maryland. The search identified several hundred articles, journals, manuals and books in print on the subject of composting. Some sources were eliminated because they did not pertain strictly to composting of yardwastes, but included other wastes such as MSW, sludge, manures, etc.

A complete listing of all articles, journals, books and manuals used in compiling information for this report is included. For easier reference, the bibliography is divided into the following sections:

1) Marketing/Utilization
2) Studies, Systems, Surveys
3) MSW Separation, Europe
4) Leaf and Yard Wastes
5) Co-composting
6) Techniques/Principles
7) Soils/Toxins/Agricultural Uses
8) Horticultural Uses
9) Waste Wood
10) Landfills/Renovation
11) Books
12) Manuals

A major source of information on yardwaste composting is the monthly magazine "Biocycle, The Journal of Waste Recycling", published by JG Press, Emmaus, PA. Although it is not strictly a compost journal, it contains articles each month on technologies, marketing, equipment and uses of yardwaste compost. There is limited information in refereed technical journals about yardwaste compost per se, although there is much information on other types of composting (MSW, co-composting sludge, manures, etc). These technical journals are, however, good sources of articles pertaining to principles involved in composting, and even to horticultural and agronomic uses of different types of compost. For example, there are a number of articles available on horticultural uses of shredded bark and wood wastes in potting soil mixes.

Several books on composting are available. These provide good references on principles, theories and engineering aspects of composting. Probably the best all-around sources of information are the yardwaste composting manuals from the states with statewide programs in place. New Jersey, Massachusetts, Connecticut, Wisconsin, Michigan, Minnesota and others have manuals in print.

Site Visits

A number of sites around the country were considered for visits, based on the study done for the EPA by Kashmanian and Taylor (1988). Phone contacts were made and sites were chosen to provide a wide variety of designs and technologies used in different parts of the country. Sites were not chosen because of a high level of technology but rather to observe a wide range of methods employed in composting yard wastes. Several of the sites specialized in recycling woody wastes, others leaves only, and some a combination of all types of yardwastes. Based on this criteria, and a limited travel budget, the following operations were visited:

1) Cooperative Waste Industries, St. Paul, MN.

This is a private leaf composting operation that is experimenting with mixing grass clippings with leaves. They also have a pilot project evaluating the mixing of restaurant wastes, including paper, with leaves.

2) Pacific Topsoils and Snoshomish County Government, Everett, WA (Seattle).

A private company that accepts woody wastes and demolition debris from homeowners, landscapers and contractors. Yardwastes, woody wastes and construction scraps (no painted or treated wood) are ground, with the smallest chips stockpiled to be mixed with soil for sale as topsoil. The largest fraction (overs) is either reground or sold as mulch or as resource derived fuel (RDF). Snoshomish County, Washington has a recycling budget of 1.7 million dollars per year. They have major activities in many areas of recycling including yard and woody waste.

3) Metro, Portland, OR.

Metro is the Portland metropolitan area agency for recycling. They have a very progressive recycling program in place. The city contracts with two local companies to accept Portland's leaves and other yardwastes. These two private companies compost the wastes and blend the compost with soil and other components to make several different products for sale. Metro also maintains quality control on the products, testing them for nutrient content, pH, toxins, etc. Metro has just completed a very impressive public relations campaign on yard waste. They contracted with a public relations firm for a three year, $185,000 per year advertising campaign. The campaign used television, radio, newsprint and billboard advertisements to increase the awareness of all citizens of problems associated with yardwaste management. Preliminary evaluation shows a major increase in awareness of the general citizenry as a result of the campaign.

4) Davis Waste Removal, Davis, CA.

Davis is a uniquely environmentally oriented city in the Sacramento Valley in northern California. They have a voluntary MSW recycling program in which 63% of the

households participate. Davis Waste Removal uses a minimal level of technology for their leaf compost windrows. The material is piled, turned infrequently and is allowed to compost on it's own. This does not generate a high quality end product. The material is offered to the public to pick up for free. The "Claw", a pincer-like bucket on a front-end loader used for curbside yardwaste collection, was developed at Davis.

5) Zanker Resources, San Jose, CA.

This is a woody waste recovery operation near San Jose. They accept all types of woody wastes, as long as it has no painted or treated wood in it. They have a log splitter in operation that will split stumps up to twelve feet in diameter (to accept giant redwood). After the stumps are reduced to a manageable size, a crew with chain saws cuts it into firewood. It is sold to the public at about one half the market price for other firewood. In another area of the operation, tub grinders reduce wood to mulch, RDF, or to be mixed and sold as a soil amendment. They are also conducting a pilot study with the city of San Jose to compost yardwaste using low level technology.

6) Ticonderoga Farms, Loudoun Co.,VA.

This is a privately owned Christmas tree farm that is accepting land clearing debris including stumps and logs. The material is stockpiled in a mix with brush and some soil and allowed to set for five or more years to decompose. The material will then be spread on the land to improve poor soil conditions. The owner of the farm, Mr. Peter Knop, is an environmental farmer and plans to use the decomposed woody material to improve the soil on his land. The material is piled into large windrows approximately 18' high x 50' wide x 500' long. The piles are irrigated and the runoff caught in ponds located below the piles. He is experimenting with growing a viney cover over the piles to maintain a high moisture level, and inoculating the wood with white rot fungus to speed decomposition. The piles are placed in areas of the farm most in need of soil improvement, to be spread in that area when decomposed. The number and location of windrows are limited in order to assure adequate area for spreading the material and minimizing offsite visibility. This technology is currently unproven, but if successful, may offer an alternative management tool for land clearing debris. Because of this strong environmental interest, Mr. Knop is taking an environmentally conservative approach. If the practice were widely used, regulatory attention should focus on limitations on types of materials allowed, of windrows versus available land, and windrow location/visibility.

7) Alternate Disposal Systems, Inc., Parlin, NJ.

This private company accepts land clearing, woody waste and clean woody demolition waste. Like others, they do not accept treated or painted wood. They designed and use a specialized grinder that works using a different principle than either a hammermill or tub grinder. (See the equipment section for a more detailed description). The wood is ground to different size chips and sent by conveyer to a shaking screen where chips of a certain size will fall into a pile. Larger chips, or "overs", are sold to be used as temporary road bases on construction sites. This company also markets a line

of chippers from a small portable unit capable of handling materials up to 6" in diameter, to large machines capable of chipping stumps several feet in diameter.

8) Dr.Peter Strom, Rutgers University, New Brunswick, NJ.

Dr. Strom is a professor in the Environmental Sciences Department at Rutgers University. He has been doing research in the area of yardwaste composting for several years, and, with Dr. Melvin Finstein, wrote the "Leaf Composting Manual for New Jersey Municipalities". He recommends of minimal to low technology composting, and is conducting research evaluating different mixes of leaves and grass clippings. While the minimal technology does work, he has observed problems with this method. Odors are the most common problem as the piles become anaerobic in a short time if the piles are not turned. Also, the process can take up to three years and the finished compost is not a high quality material.

9) Middlebush Compost, Inc. Middlebush, NJ.

This is a very well managed, moderate technology leaf composting operation. It is on a 25 acre site and has a 200,000 cu yd capacity. The windrows are 18' high x 18' wide x 120' long. The temperature inside the piles is monitored and when it reaches 140 degrees F, the windrows are turned using a Scarab 18 mechanical windrower. The piles are turned approximately once a week, but more often when first formed. They are producing a very high quality compost in nine months. The finished material is sold screened, or unscreened. This high quality compost is becoming well accepted for use by nursery operators, landscapers, etc.

10) Dickerson Composting Facility, Dickerson, MD.

The Dickerson facility, run by Maryland Environmental Services, is on a site that in the past was used for sludge composting. It is a 47 acre paved site, that currently is taking about 97,000 cu yds of leaves a year, however, they have begun experimenting with a pilot grass collection program. This past summer (1989), they collected grass from 2400 households and received 500 tons of clippings since April. They are experimenting with mixes and feel they can go to a 2:1 leaves to grass clipping mix. Next year the grass collection program will be expanded to all 300,000 households in the county which will double the yardwaste volume they receive. They use a Cobey windrow turner, that was formerly used with the sludge composting operation. They are supposed to turn the piles on a monthly basis, however, some piles had not been turned for a longer period. There were plastic bags in many of the windrows, especially the ones with grass clippings. They have tried using biodegradable bags, but have not had good results with them. After composting and screening, they were turning out a high quality product in about one year but more attention to turning the piles on a regular basis would turn out a high quality compost in a shorter time period.

Surveys

Three surveys were developed to determine the amount of compostable yardwaste produced, the perceived uses of compost, and interest in composting and compost utilization. These were population surveys, directed to people in Virginia who would either have uses for compost, knowledge of amounts of yardwastes going into landfills, or perceptions of how compost could be used by citizens of the state.

The surveys were mailed in July and August, 1989. One week after the initial mailing a reminder postcard was sent to thank people who had already responded, and to remind those who had not. The data from the surveys was then entered on a computer and analyzed. A discussion of each of the surveys follows. (A copy of each of the surveys can be found in Appendix B). Discussion and interpretation of survey results are included in various sections of the report.

1) Virginia Nursery Operators Survey

In order to help assess potential uses, use volumes and private sector interest in composting, all registered nursery operators in the state were surveyed to determine current uses of organic materials for mulches, potting mixes, etc., and ways composted yardwaste could be used. Thirty-one percent (147 of 476) of all nursery operators responded to the survey. Over two-thirds of the respondents were sufficiently interested in making or using yardwaste compost that they asked to be put on a mailing list for further information. Locations, by city or county, of interested nurseries are shown in Figure 1.

2) Virginia Cooperative Extension Agents Survey

Extension Agents are in the unique position of having first-hand knowledge of local government and of how Virginia farmers and gardeners would use a material such as yardwaste compost. Many of them are involved in or aware of local programs in recycling and composting.

Seventy percent (86 of 123) of the Extension Agents-Agriculture, representing nearly 3.4 million people, responded. Their perceptions on current yardwaste management, uses for and interest in yardwaste compost, and areas of public education needed, were important in formulating recommendations for this feasibility study. Thirty one respondents (36%) said they would like for their locality to be considered as a participant in a pilot program. The location of interested cities or counties is shown in Figure 2.

3) Virginia Solid Waste Management Permit Holder Survey

Solid Waste Management Permit Holders were surveyed to determine: a) the expected life of their landfill, b) the amount of yard waste currently received at the landfill, c) awareness of programs in other states to recycle organic wastes, and d) perceptions

of the feasibility of a composting program in their locality. Forty-seven percent of all permit holders responded indicating a high level of interest in yardwaste composting.

Telephone Interviews

Telephone interviews were conducted with people in areas of the country not visited, either due to time or budgetary constraints. The people interviewed included researchers, regulators, recycling coordinators, and compost facility operators. A list of contacts is included in Appendix A.

Figure 1. Location of Nursery Operators Wanting Additional Information On Compost Use and/or Operating A Compost Facility

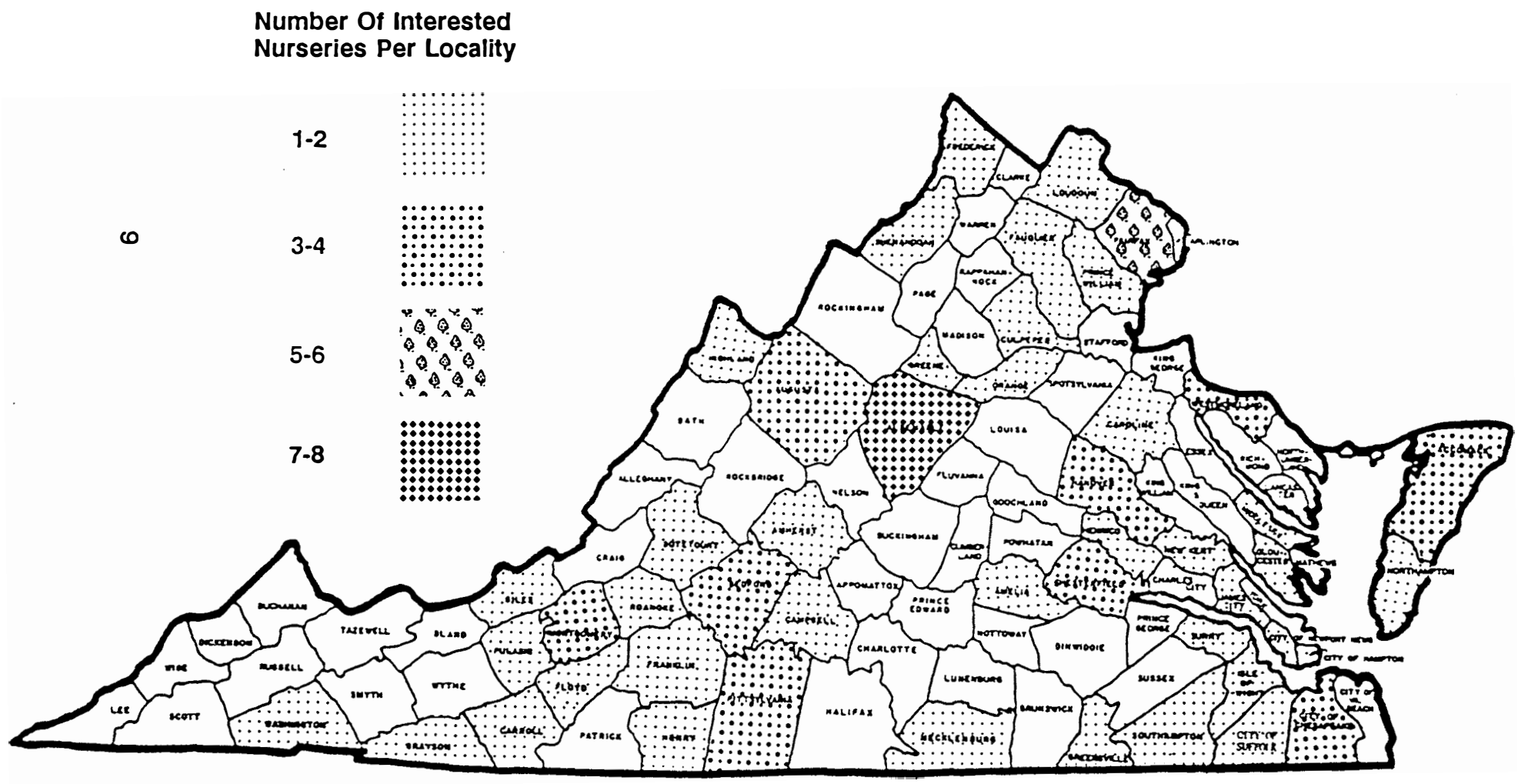
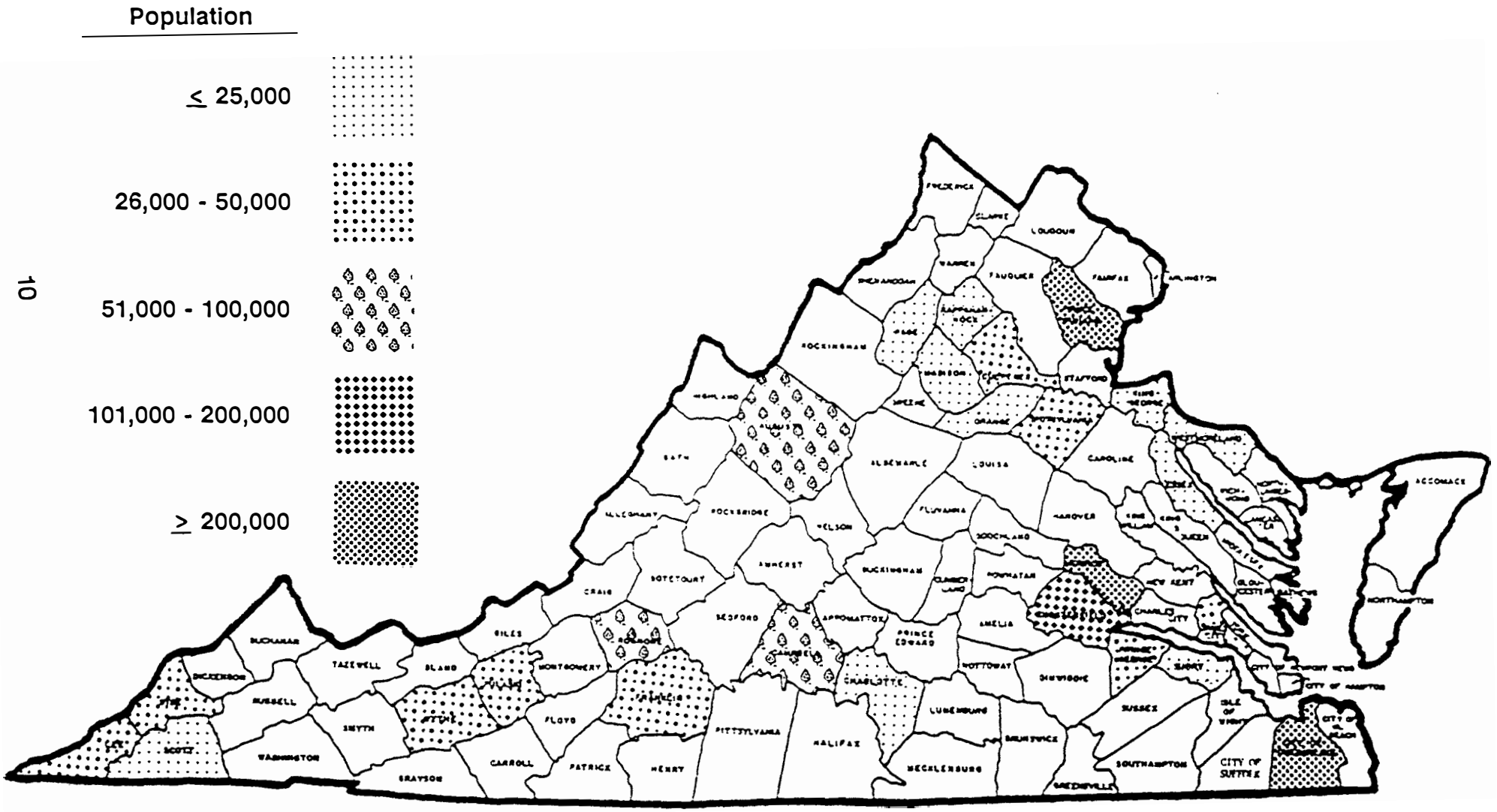


Figure 2. Cities or Counties (By Population) In Which Extension Agents Expressed a Strong Interest In Being Considered As A Location For A Demonstration Or Pilot Program



CURRENT YARDWASTE MANAGEMENT PRACTICES IN VIRGINIA

Currently, 76% and 81% of the Solid Waste Management Permit Holders surveyed landfilled all of their leaves and grass clippings respectively. Seven percent stockpile both leaves and grass clippings and use a giveaway program in combination with landfilling to manage leaves. The remaining permit holders use some other method or combination of methods to manage yardwaste.

The average annual percentage of MSW that is yardwaste was estimated by respondents to be nine percent. This is substantially below most estimates from other states and more quantitative numbers generated by waste stream inventories. It appears that most permit holders may have only accounted for bulk quantities of leaves. Based on available information from Virginia and elsewhere, it is estimated that yardwaste accounts for 15 to 20% of Virginia's MSW. This does not include woody waste which likely accounts for about the same volume as yardwaste. It should be noted that yardwaste volumes can range from 5 to 40% of the total waste stream at different landfills.

Nearly one third (32%) of the respondents have a separate curbside collection program for leaves. This facilitates segregation of the materials for composting. For localities without curbside collection, efforts to segregate yardwaste either during or after collection will be critical in developing a successful yardwaste composting program.

No locality currently composts more than 10% of their yardwaste. However, more than one third (34%) of the respondents have established a group to study recycling of yardwaste as compost. The intense interest in yardwaste compost is indicated by the high level of response to the survey (47% of all permit holders) and the large number of respondents requesting to be put on a mailing list for additional information on yardwaste composting (Figures 3 and 4).

The interest in yardwaste management is further intensified by the large number of landfills nearing capacity. Over half (52%) of the respondents indicated their landfill had an expected life of less than ten years. Of that number, 36% have selected a new site and are in some phase of design or construction. The short life expectancy of so many landfills and the cost of new landfill space dictates that all recyclable waste, such as yardwaste, must be removed from landfills.

If a conservative average of 15% yardwaste is used with an approximate total MSW volume of 6.5 million tons per year, then almost one million tons or approximately four million cubic yards of yardwaste are collected in Virginia each year with the vast majority going to landfills. The average landfill tippage fee for survey respondents was $19.63 per ton. Based on projected yardwaste volumes and the average tippage fee, landfill space valued at almost 20 million dollars are being used for yardwaste. As stated earlier, an approximately equal volume (and cost) is associated with woody waste. This suggests

that the total cost of disposing of yardwaste and woody waste in Virginia is nearly 40 million dollars annually. Further, tippage fees are rising rapidly as new landfill space becomes increasingly difficult to locate. It should also be noted that 46% of responding landfills charged less than $10/ton which is unrealistically low. These are likely older landfills that have not yet included the costs of upgrading to meet new requirements. It can thus be concluded that the real cost of yard and woody waste management, when viewed in terms of future availability of landfill space, should be far in excess of 40 million dollars per year.

Figure 3. Number of Landfill Managers Responding Per Planning District

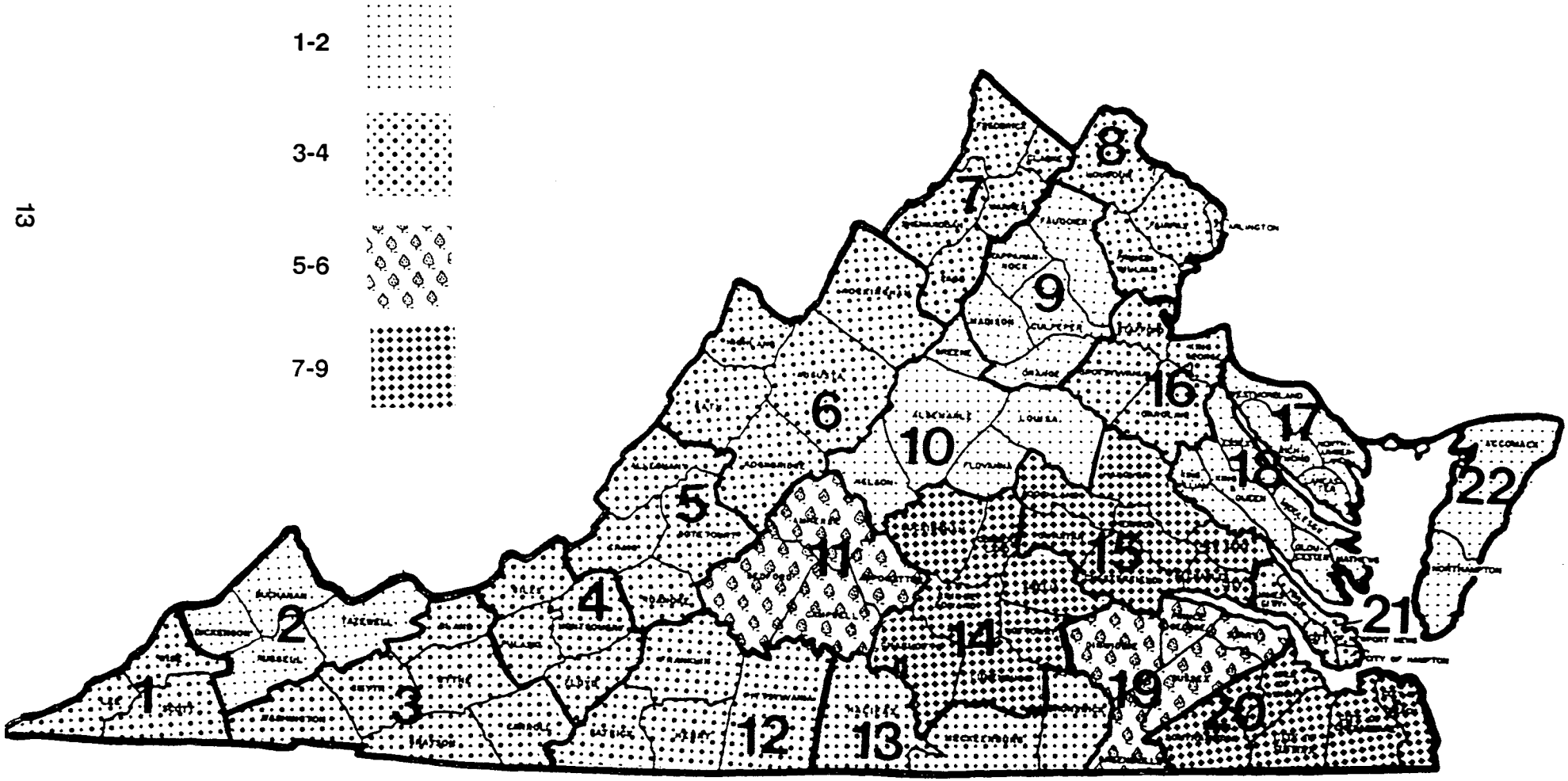
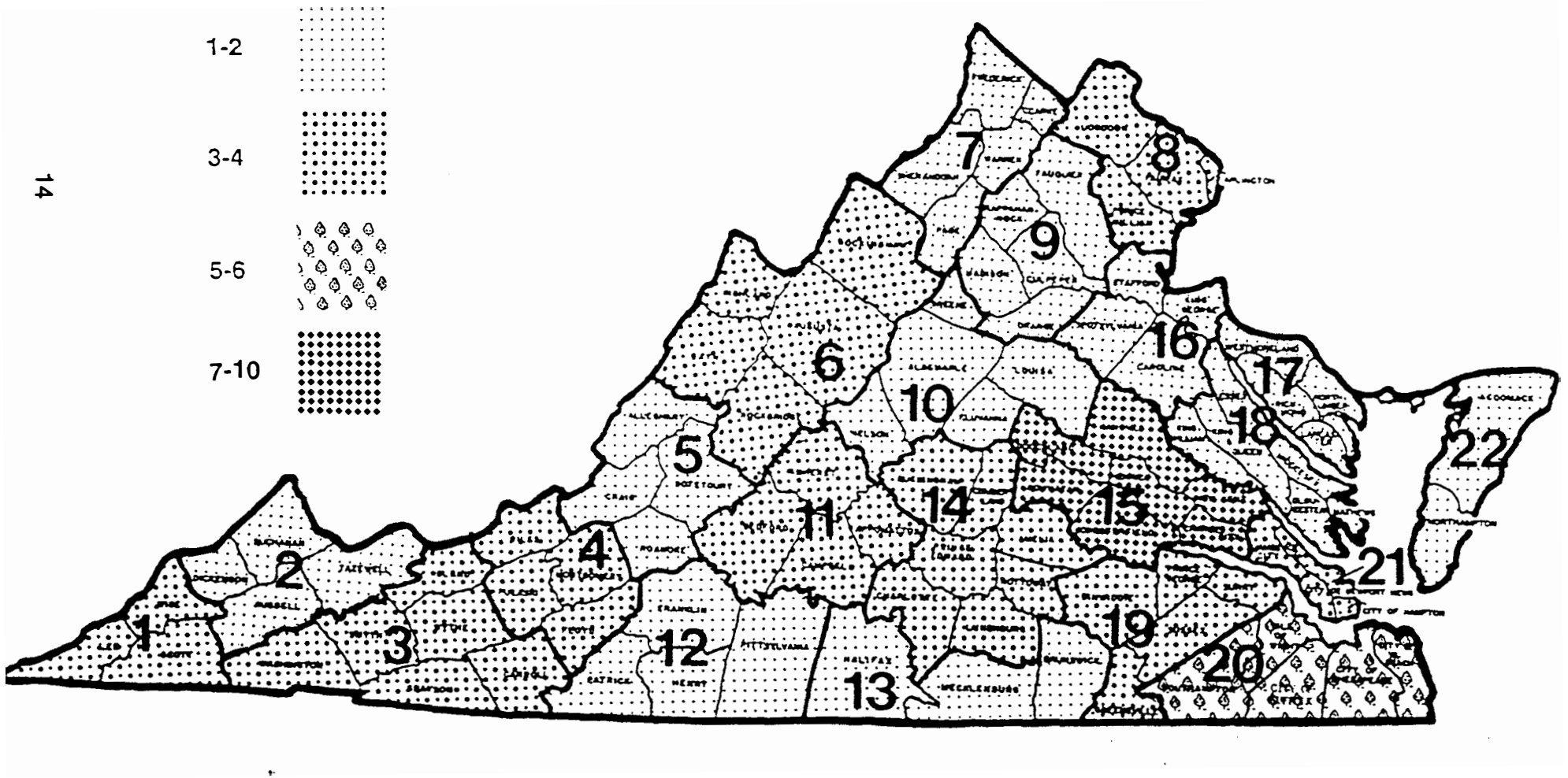


Figure 4.

Landfill Operators by Planning District Interested
In Additional Information On Composting Yardwaste



MARKETS AND USES FOR YARDWASTE COMPOST

Based on results of surveys sent to Virginia Nursery Operators, a number of organic matter sources currently in use could be replaced by yardwaste compost. Fifty-six percent of the respondents felt compost could be substituted for commercial potting soil mixes and many felt it could be substituted for peat moss. Over 94,000 cubic yards of potting soil mix and 36,000 cubic yards of peat moss are used by respondents per year. If all of the peat and one-half of the potting soil mix could be replaced by compost, a potential market of about 95,000 cubic yards of compost per year would result from survey respondents only.

By replacing all of the peat moss and half of the potting mix sold by responding nurseries, an additional 41,000 cubic yards of compost could be used (only half of the potting mix was assumed replaced since a good potting mix must contain a substantial portion of organic material). This results in a total potential market of 136,000 cubic yards of organic material used or sold by survey respondents. It is not statistically appropriate to directly extrapolate population survey results to the entire population. Therefore, total market volume can only be estimated. It is estimated that a total potential market volume two to three times that reported by respondents, or ranging between 272,000 and 408,000 cubic yards, could be anticipated. However, this assumes that the most commonly used organic materials would be replaced entirely, which is unlikely. Nursery operators and extension agents also felt the material would be suitable for use in lawn establishment/ renovation and home garden soil improvement.

There are apparently some misconceptions about potential uses of yardwaste compost even among extension agents and the nursery industry. When finished, yardwaste compost is a very dark, crumbly material, that is fine textured. It would not be a very suitable material to use as a mulch, but many of the nursery operators and extension agents who responded listed mulch as a major compost use, to replace shredded bark. It also is low in nutrients and not well suited as a nutrient source, although some nursery operators and extension agents listed this as a major use.

In addition to replacing potting soil mixes and peat moss, yardwaste compost is an excellent soil conditioner. Incorporation of compost into areas for flower beds or field-grown nursery crops also represents a substantial potential market a potential use for compost. Fifty four percent of the nursery operators felt the material could be used as a soil amendment in field nursery crops.

It is also likely that state and local government agencies could make use of large quantities of the material. In Minnesota, the Governor has issued an executive order requiring use of composted yardwaste when available, of comparable quality and competitively priced. Given the need to increase use of compost in Virginia, the state should require and/or encourage use of yardwaste compost by state and local governments. It is also apparent that the public, including state and local agency personnel, are unaware of the potential uses of yardwaste compost. A public education program on the use of compost should result in substantial increases in the use volume.

Based on the projected total yardwaste volume of four million cubic yards per year, about 800,000 cubic yards of compost could be generated. However, as will be discussed later, technologic constraints make it desirable to minimize the amount of grass clippings in the material to be composted. As a result, programs to minimize grass clipping removal will be recommended. If these programs are successful, annual yardwaste compost volumes should be less than 600,000 cubic yards. Potential use and sales by nursery operators could account for about 50% of that volume. Increased use by state and local government will account for a substantial amount of the remaining compost. A public education program will result in substantial increases in homeowner use. It is estimated that with the programs recommended to increase compost use, backyard composting, and to reduce collection of grass clippings, the total volume of yardwaste generated in Virginia can be recycled and utilized. Care must be taken to minimize market competition among localities in the major metropolitan areas. However adequate use/market appears to exist within reasonable distances to handle the yardwaste compost supply. A list of potential user groups for which markets could be developed is included in Appendix C.

REGULATION OF YARDWASTE COMPOST

In those states with active programs, approaches to regulation of yardwaste compost facilities vary. In several western states, yardwaste only compost facilities are not currently regulated or are accepted as part of the solid waste management operation without amendment to the permit. On the east coast, yardwaste facilities are usually regulated by the state solid waste management regulatory agency. However, in most cases, regulations for yardwaste compost facilities are less stringent than those for other compost operations.

In New Jersey, small to medium yardwaste compost facilities operated by farmers on their farm are exempted from most regulations. Publicly operated minimal technology facilities are loosely regulated primarily concerning management practices to minimize odors. However, larger private facilities without land on which to use the compost are regulated by the state Department of Environmental Quality. Private sector composters in New Jersey are not satisfied with the regulatory framework, particularly with respect to the publicly owned minimal technology facilities. These facilities are low cost but do not generate a high quality product and private operators feel they are a means of long term stockpiling of yardwaste instead of compliance with New Jersey's mandatory yardwaste composting regulations. This reduces the volume of materials available to the private composters and has resulted in an inadequate supply of yardwaste at some facilities.

Minnesota is using the "permit by rule" approach to grant approval to yardwaste compost facilities. In Minnesota, the perspective composter submits a two page form letter requesting approval for a facility. The letter includes information on the location, types of materials to be accepted, maximum annual volume, ownership and operational information. The letter is sent to the Minnesota Pollution Control Agency where it is reviewed and approved (if deemed acceptable) within two weeks. The operator must submit an annual report detailing the types and volume of yardwaste received and the volume and disposition of finished compost. The Minnesota Pollution Control Agency can require the facility to obtain and operate under a solid waste management permit if substantial environmental or nuisance problems arise.

Currently, yardwaste compost facilities in Virginia are regulated under Section 6.1 of Solid Waste Management Regulations. These regulations were clearly written for general MSW refuse or refuse mixed with sludge and are therefore necessarily restrictive. Section 6.1 requires an impermeable pad, leachate and runoff control, collection and treatment and numerous other site restrictions. In addition, routine monitoring of air, water, waste and compost are required. While such stringent regulations are understandable and necessary for refuse and sludge composting, they represent the most restrictive regulations observed for yardwaste composting facilities.

If Virginia is to implement a statewide yardwaste composting program, separate regulations for yardwaste facilities must be developed. The "permit by rule" approach used in Minnesota provides a rapid and simple means of obtaining approval for a

yardwaste composting facility while still allowing more stringent regulation should problems arise. This approach should be used for approving public and private facilities that do not have land on which to use the compost. Farmers and nursery operators accepting small quantities of yardwaste (less than 5000 cubic yards per year) should only have to notify DWM of their intent to accept yardwaste and their location.

YARDWASTE COMPOSTING TECHNOLOGIES

For any compostable material, there are several technologies available for composting. The most appropriate technology is a function of the material, available land area, nuisance potential, equipment availability, available resources, potential environmental harm and regulatory requirements. Strom and Finstein (1986) classified yardwaste composting procedures into four levels of technology based on equipment and resource requirements, composting time, land area requirement and quality of the finished product. These four levels are discussed below.

A. Minimal Technology

Generally, this technology is best suited to a locality that has a large site, isolated from heavily populated areas. At least one acre for every 4,000 cubic yards of collected leaves is recommended (Strom and Finstein, 1986). This does not include any buffer zone, the size of which will vary for each site dependent upon location and regulatory requirements. The yardwaste is brought to the site and immediately formed into large windrows, (e.g. 12 ft. high by 24 ft. wide) using a front-end loader. Though it is not essential, the yardwaste may be wetted while the windrows are formed. Wetting may be necessary only in dry years, since the large piles will conserve moisture and will be exposed to precipitation. The piles are only turned once a year and it takes 3 years or more to get a finished product.

A serious limitation for this system is that the pile becomes anaerobic in a short period of time and will only receive a new supply of oxygen each time the pile is turned. The center of the pile may also reach inhibitively high temperatures (> 140 F,60 C) especially during the first year. Also, unpleasant odors will be produced in this anaerobic environment, and will be released into the air even without turning the pile. At one apparently isolated site in New Jersey, ten odor complaints were filed during the first eight months of 1989. A quarter of a mile or more between composting windrows and neighboring land-uses is recommended as a minimum buffer zone.

The main advantage to this system is that it is relatively inexpensive, requiring little equipment and labor. A front-end loader is only needed to form the initial windrows and to do the yearly turning. Screening and grinding of the finished product is required if the compost is to be sold or given to the public. If, however, it were to be incorporated into farm land, screening would be optional to remove large pieces of trash and plastic bags.

The major disadvantages are the odors produced, the length of time required to get a final product, the large land area required, and the low quality of the finished product. Minimal technology is only appropriate for small volume facilities with large land areas where end product use is not a major concern. Minimal technology facilities are not likely to be acceptable for use by many Virginia localities.

B. Low-level Technology

The low-level technology system, in which moisture content, oxygenation, and temperature are all monitored and controlled will increase composting rate with minimal additional capital investment and generate a more useable end product.

To obtain the fifty percent moisture content necessary for optimum decomposition, the yardwaste may need to be sprayed with water prior to, or as the windrows are being formed. Spraying the piles after formation leads to the water running off with little penetrating to the inside of the pile. A rule of thumb for checking for proper moisture level is that it should be possible to squeeze a few drops of water out of a handful of yardwaste. About fifty gallons of water will need to be added per cubic yard of dry collected leaves with that amount reduced as the amount of grass clippings added increases.

The size of the windrows has a direct effect on the amount of oxygen that gets into the windrows, which in turn affects the temperature and the microbial activity inside the piles. The windrows should be large enough to conserve heat and moisture, and minimize area requirements, but not so large as to create anaerobic conditions or increase the temperature above the optimum for microbial growth. No single size pile can meet these seemingly conflicting demands. One possible solution is to start with two moderately sized piles, stacked close to each other, and combine them after one month. Researchers in New Jersey recommend the piles be 6 feet high by 12 to 14 feet wide, but this size may need to be increased in colder areas of the state to maintain internal temperatures. This will allow the first burst of microbial activity to occur, heating up the piles and significantly decreasing their size. The act of combining the windrows will then re-aerate the piles, and maintain adequate pile size to keep temperatures optimum allowing microbial activity to continue.

The windrows may be left as is over the winter, but as early as possible in the spring they should be turned. Again, as with the minimal-level technology, this may be done with a front-end loader. Efforts should be made to turn the piles "inside-out", thoroughly mixing them, which will re-oxygenate the interior, and expose the cooler outer edges to the warmer internal temperatures. At this turning, odors may be detected because the pile has been anaerobic for an extended period. Care must be taken to turn the pile at a time of day when odor complaints are least likely. Also, wind direction must be considered. If the piles are dry, water should be added at this time to maintain the 50% optimal level. Additional turnings during the summer are useful to increase the decomposition rate, but with this level of technology they are optional. Unless the piles are turned once per month or more frequently, the compost will not be stabilized by the time the next leaf season begins, (a finished product can be expected in 16-18 months) and room will need to be made for the incoming leaves.

The best managed low technology sites use temperature probes and turn the piles whenever internal temperatures exceed about 140 F. This may result in weekly turning during the first several weeks particularly if the piles contain a mixture of leaves and grass clippings. However, if the piles are turned more frequently based on internal temperature,

composting time can be reduced to six to twelve months and the end product is usually higher quality.

After composting, the material may be moved to a curing area around the perimeter of the site where it will continue to slowly decompose. This curing pile may be as large as needed to conserve space. At this point, the material's oxygen demands are low and production of odors is unlikely. Again, grinding and screening of the finished material is optional, but is recommended to improve the appearance of the product. Screening can also help to break up large pieces and remove any unwanted materials such as branches, rocks, plastic, cans, etc. This step is fairly labor intensive, and requires the purchase of additional equipment. One way to reduce costs is be to share a shredder/screener between neighboring operations.

Low level technology requires less total land area and produces finished compost in a shorter time than minimal technology. The finished compost is of moderately high quality for use after grinding and shredding. The primary disadvantages are increased labor and equipment use and the fact that more than one year may be required to complete composting. Low level technology in which the materials are monitored and frequently turned so as to achieve composting in less than one year, may provide the most appropriate technology for many small and medium composting facilities.

C. Intermediate-Level Technology

This next level of technology requires the purchase of specialized equipment, but can produce a finished compost in less than 6 months. For this technology, a mechanical windrower is used to turn the piles. The size of the windrows is restricted by the height and width of the windrow-turning machine which is usually not greater than 8 feet high by 12 to 18 feet wide. There are several types of windrowers available, some straddle the windrow, while others turn half of the windrow during each pass. (These will be discussed in more detail in the section on machinery). These machines vary widely in their cost, capabilities and flexibilities. Some can be attached to the PTO of a farm tractor or a front-end loader, while others are self-powered units.

The use of these machines offers several advantages. The time required to produce a finished product is greatly reduced. The machine mixes, aerates and grinds the yardwaste all in one step, which can eliminate the need to grind or shred the compost as a final step.

As the yardwaste is brought to the composting area, it is wetted if necessary and turned and mixed while being formed into windrows by the machine. Additional high nitrogen wastes, such as manures can be added during windrow formation to increase the rate of composting (if leaves only are being composted). During the first few weeks, the windrows may be turned several times a week, then once per week, or once every two weeks. The need for turning should be monitored either by measurement of temperature (or oxygen concentration) within the pile. As the temperature reaches 140-150 degrees F, the pile should be turned. This temperature range is optimum for destroying pathogens and weed seeds, while allowing maximum growth and reproduction of thermophilic bacteria important in the composting process.

This technology offers several advantages. The total area required is less than with the previous technologies. The windrows can be formed close together because the windrower actually requires less turn-around space than a front-end loader. Also, as stated above, the machine will mix, aerate and grind the leaves as it moves along the piles, eliminating any additional grinding. Screening the finished compost is still necessary. The finished product is a very high quality material that is ready for use or marketing after curing.

This technology is the best available for composting leaves, leaf/grass, or leaf/manure mixes. Due to the cost of mechanical windrowers, it is probably only practical for medium to large compost facilities. Because of the shorter composting period, the alleviation of grinding and the high quality end product, it may be desirable for several localities to share a windrower or for a private sector firm to provide windrowing service to multiple localities. The disadvantage, is the cost of the windrower. However, the savings in time, land area required, and the elimination of the grinding step will help offset this cost. This is probably the most appropriate technology for medium and large facilities.

D. High-Level Technology

This last level of technology is probably not practical for most communities. It was originally used in composting sewage sludge, but has been adapted for yard wastes.

This method consists of using a system of pipes under the piles to run forced air through the piles with a blower controlled by a temperature feedback system. When the temperature inside the pile reaches a preset level, the blower automatically comes on to cool the pile and assure aerated conditions. During the initial start-up period, the blowers would come on frequently under control of a thermocouple. After 2 to 10 weeks, the aeration system would be removed and the piles turned periodically.

Obviously, this type of system is much more expensive to operate, but its advantages include the formation of large windrows to save space and the most rapid composting rate. Anaerobic conditions do not develop in these large piles due to the forced air. Composting can be completed within several months due to the rapid initial decomposition. Additional high nitrogen wastes, such as manures, could be added to the piles easily at this level of technology to speed up decomposition and raise the nitrogen content of the finished compost.

Backyard Composting

Backyard composting is the first logical step in reducing the amount of organic wastes going into our landfills. Processing yardwastes at the point of generation not only has a positive environmental impact, but the costs of collecting, transporting, processing and marketing by the municipality can all be avoided if home composting is encouraged.

Many people, especially organic gardeners, have been engaged in composting for many years as a way to improve their soil. The addition of organic matter rich compost has many beneficial effects for the soil, including:

1) increasing the water-holding capacity, and reducing the chance of erosion
2) improving soil tilth, making it easier to cultivate
3) preventing soil crusting, aiding in seedling emergence
4) the added organic matter provides a food source for desirable soil micro-organisms and earthworms
5) increasing the fertilizer-holding ability of the soil by increasing the cation exchange capacity (CEC)
6) providing some nutrients for plant growth

Overall, compost improves the physical, chemical, and biological properties of soils. Compost is not considered a primary fertilizer source, because it is low in nutrient content, but it is an excellent soil conditioner.

Municipalities should encourage backyard composting as a part of their overall yardwaste management program. Participation in backyard composting will depend in part on the public's understanding of the cost and problems associated with landfilling or otherwise disposing of yardwastes. Seattle, Washington, for example, has a program where they train "master composters" who in turn give demonstrations and advice on backyard composting to other people.

There may be local ordinances in some areas that discourage or prohibit backyard composting. While it is true that not all backyard composting operations are an asset to the neighborhood or the environment, if properly constructed and maintained, a compost bin need not produce objectionable odors or attract unwanted animals.

According to surveys sent to Virginia Cooperative Extension agents, the percentage of Virginians who backyard compost is approximately 11%. Informational pamphlets on backyard composting need to be developed and distributed to increase public participation. The VCES has several publications on the subject. "Composting", publication #426-325, "Mulches For The Home Garden", #426-326, and "Soil Preparation", #426-313, are all good sources of information on the preparation and use of compost.

Efforts should be made to increase backyard composting. Not only are savings made in landfill space but the cost of collecting and transporting the material is avoided. The potential savings are so great that even modest increases in backyard composting would justify a substantial public education effort.

The Potential for Composting Yardwaste With Other Organic Wastes

The microorganisms that actively decompose organic matter have a few simple requirements. Balanced nutrients, adequate moisture, proper temperature range and adequate oxygen are all that is needed to keep the decomposition process moving at a rapid rate. A little attention to and adjustment of these needs will keep the process going and keep odors to a minimum. Microorganisms need nutrients, primarily carbon and nitrogen, for both energy and growth. The ideal carbon:nitrogen ratio is nearly found in any one organic source. While leaves by themselves will compost adequately to oxygen, with temperature and moisture are controlled, they still have a high carbon:nitrogen ratio which can slow the decomposition process. The addition of a high nitrogen source will accelerate the process, but it must be carefully controlled. Yardwaste compost, by itself, is a very low nitrogen-containing soil amendment. The addition of a high nitrogen source would possibly make it more suitable as a fertilizer source. Too much nitrogen can result in too rapid decomposition and anaerobic conditions that create odor problem.

Grass clippings are a high nitrogen yardwaste component that is being studied to determine the appropriate mix with leaves in a compost systems. Research in several locations indicates that a mix of three parts leaves to one part grass may be as optimum for windrow composting. The same research suggests the maximum amount of grass clippings is one half the leaf volume (2 parts leaves to 1 part grass). Any higher amount of grass clippings causes serious anaerobic conditions, leading to odor problems.

The amount of grass clippings collected each year is approximately equal to the amount of leaves collected. The problem of maintaining this 2 to 1 leaves to grass ratio comes from the fact that after leaves are collected in the fall and windrowed, they undergo a substantial reduction in volume due to the burst of microbial activity that occurs within the first month of composting. By the time grass clippings are being collected the following spring and summer, the leaves have been reduced in volume by about 50%. Thus the actual leaf to grass ratio would be 1 to 2 instead of the desired 2 or 3 to 1 if all grass clippings were collected and composted. Such a ratio would result in rotting grass, anaerobic conditions, poor end product quality and intolerable odor.

Efforts must be made to reduce the quantity of grass collected. Research has shown that grass clippings do not need to be removed from lawns. If lawns are mowed frequently, and the clippings allowed to fall back into the lawn, their collection is not necessary. Grass clippings, being high in nitrogen will decompose rapidly and actually return nitrogen to the soil, reducing the need to apply nitrogen in the form of fertilizers. Homeowners and land managers who collect grass clippings should be encouraged or required to manage (compost) their own grass clippings.

Other high nitrogen solid organic wastes, such as poultry litter, have potential to be added to leaf compost windrows. It is estimated that a ratio of 5 to 8 parts leaves to one part poultry litter would be appropriate. Pilot studies need to be conducted in areas of the state where poultry litter is available to determine the optimum mixture of leaves and

poultry litter for composting. Other sources of dry animal manures also need evaluation as possible nitrogen sources for yardwaste composting systems.

Sewage sludge, industrial wastes and liquid animal waste are all suitable for mixing with leaves for composting. However, the use of these materials will require major site modification, leachate and runoff control, ground and surface water monitoring, air and waste monitoring and much better process control. As a result it is generally not desirable to mix these wastes with leaves to increase the rapidness of composting.

COMPOSTING EQUIPMENT

Equipment requirements for composting vary substantially with the type and size of operation. This section briefly discusses the major types of composting equipment available and provides preliminary cost estimates. Any mention of brand names of equipment does not constitute endorsement of that equipment. (The information in this section is based primarily on "Municipal Yardwaste Composting, A Handbook for Wisconsin Communities", Dane County Dept of Public Works, July, 1988.)

A. Front-end Loaders

Both track loaders and wheel loaders may be used in composting operations. The track loader operates better in loose or muddy soil, but is not as easily transported if the equipment needs to be moved to another site. The wheel loader is more versatile, more easily maneuvered, and causes less damage to road and ground surfaces.

Both types of loaders come in a variety of sizes with a variety of standard and optional accessories. They are usually equipped with diesel engines, but models using gasoline and other fuels are available. Bucket sizes range from 3/4 to 4 cu. yd. Other attachments, such as a "claw" and a windrow-turning machine are optional. A front-end loader is the one essential piece of equipment for all yardwaste composting operations, and the only equipment used by many .

Prices for a new front-end loader range from about $50,000 to $150,000, depending on size and accessories.

B. Vacuum Leaf Collectors

Vacuum leaf collectors are designed to collect leaves that have been raked into the street or along the curb. Tag-along units are towed behind a truck, into which the leaves are blown. Self-powered units are also available, some with compaction capacity up to 32 cubic yards per load. Most have manually operated intake hoses, ranging from 7 to 18 inches in diameter. Some models include an internal shredding system. This equipment works best with fairly dry leaves and cannot be used for collection of grass clippings.

Trailer vacuum units cost from $15,000 to $20,000. Self-contained units cost from $50,000 to $110,000.

C. Grinders

1) Tub grinders are characterized by a rotating tub-type drum intake system. The material is loaded with a front-end loader into the tub and moved across a fixed floor containing hammermills that shear the material. As the material is reduced in size, it is forced through a screen and onto an elevator belt that discharges the material into standing piles or onto a transfer vehicle.

Tub grinders are available in different models, which have significantly different capabilities. Forage grinders are lighter-duty machines designed for grinding crop wastes such as straw, corn stalks, etc. These may be suitable if grinding only yardwastes. Larger heavy-duty grinders are made for grinding large amounts of dry wood and brush. These machines are capable of handling from 10 to 20 tons per hour depending on factors such as type of plant waste, screen size used, and waste moisture content. Although the larger units are capable of grinding pieces of wood up to four inches in diameter, the machine will occasionally jam. Proper mixing of wastes and use of varying screen sizes will reduce jamming and increase efficiency.

Tub grinders cost from about $60,000 to $140,000 delivered and require regular maintenance, including rotation and replacement of the hammers. A new set of hammers costs approximately $900 to $1400. Down-time to replace hammers is several hours. Hammers need to be rotated after about 50 hours of use and replaced after 140-240 hours of use.

2) Special Design Grinders

This type of grinder is similar to a tub grinder in design, but has been built with a special purpose in mind. Alternate Disposal Systems in New Jersey has designed a woody waste grinder that will accept logs and stumps several feet in diameter. The grinder has a set of rollers with teeth and blades to impale and hold the wood. The wood is rubbed against the rollers and reduced to small pieces in a short time. The shredded material is then moved by conveyers to be sized and screened.

There are several models of grinders available, from a small portable model that will accept up to six inch wood, machines with increasing capability up to a model powered by a 350 hp diesel engine, that can handle logs several feet in diameter. They range in price from $10,000 for the small model to over $450,000 for the largest model.

D. Chippers

Chipping machines are designed to chip brush, limbs and other woody debris. Chippers are typically hand-fed and have blades that range in size from 12 to 16 inches, but will only handle material up to about 6 inches in diameter. Some models are equipped with heavy-duty blades that can handle an occasional can or rock without damage to the machine. Chippers produce large chips, suitable for mulch. Chippers are powered with gasoline or diesel engines or from a power take-off shaft.

Chippers cost from $10,000 to $40,000. Replacement blades cost from $70 to $200 and may last up to a year.

E. Shredders and Screeners - Finishing Equipment

Shredders and screening devices are frequently used to refine or finish the compost. After the material is loaded into a receiving hopper it is carried to the top of a conveyer. The conveyer drops the material onto a belt, and by a system of adjustable,

variable sweep fingers, the material undergoes a continuous raking action to shred and aerate the load. Oversized pieces are forced back for further shredding while items such as sticks, stones, metal and glass are rejected and discharged through a trash chute. Shredders can process from 25 to 250 cu yd per hour and cost from $30,000 to $95,000 depending on size and options selected.

There are a variety of screening devices that can be used in compost operations, including grizzly screens (scalpers), trommels (rotating screens), and shaking/vibrating screens. Grizzly screens are used primarily for crude screening at 2 inches or more, trommels and shaking screens for separations above 1/2 inch. Vibrating screens can be used for coarse or fine screening, depending on the configuration of the screen.

Vibrating screens and trommels come in a wide range of models, sizes, and prices. Units capable of processing from 25 to 50 cu yd per hour range in price from $35,000 to $170,000 including screens, feed hoppers, and conveyers.

F. Compost Turners

Compost turners are designed especially for windrow turning and aeration. The large models are self-propelled and straddle the windrow. Middlebush Compost in New Jersey uses a Scarab model 18 to turn windrows at a 200,000+ cubic yard per year facility. This machine has metal teeth on a rotating drum and as it moves over the windrows, the teeth shred, break up, and aerate the compost. A skirt or fender reforms the windrows into a pyramidal shape.

Smaller units that are side mounted on front-end loaders or tractors are available. This type is driven down one side of the windrow then up the other, requiring two passes for each pile. These also come in a variety of sizes and are well suited for small and medium operations. A windrow turner is a necessary piece of equipment for a compost operation to rapidly produce a high quality product.

The large, self-contained units can process from 2,000 to 4,000 cu yd per hour and cost from $100,000 to $185,000 delivered. The loader/tractor mounted units are designed to turn smaller windrows and cost from $10,000 to $60,000. The major maintenance requirement of turners is regular replacement of the flails or teeth that cost from $375 to $500 per set.

G. Monitoring Equipment

Thermometers may be the only instruments needed to monitor the composting operations. Other testing equipment, such as pH meters, colorimeter tests, moisture monitors, etc are optional.

There are two types of thermometers that are useful for composting: the long-stemmed dial type and the infrared scanner. The long-stemmed type should be 2 to 4 feet long so it can be inserted into the middle of the windrow. Several should be inserted into each windrow for daily readings and removed when the windrows are turned. These

cost about $50 each. They are also available in a digital read-out model that cost about $500 each.

The infrared scanner contains a sensor module that converts radiant energy to an electrical signal. They are hand-held and can be used to measure the temperature of all sections of a windrow at a distance. Infrared thermometers cost about $1200 including the basic accessories. A partial list of equipment manufacturers and venders can be found in Appendix D.

Evaluating the Cost of Yard Waste Composting Options

Since Virginia municipalities vary widely in their size, location, landfill tippage fees and availability of suitable land for a compost site, there is no best approach or strategy for leaf composting. In terms of size and ownership of facilities this section discusses three types of compost facilities that may be needed to serve the various size municipalities. 1) The small farmer or nursery operator facility, with generally 5,000 cubic yards per year of compost or less, 2) the medium size prevatior municipal facility accepting 20-30,000 cubic yards per year, and 3) the large private commercial facility accepting 80,000 cubic yards per year or more. [This section is based primarily on an article by Derr (1989)].

1) The smallest and least costly compost operation is the on-farm or nursery operators facility. Small communities that have open agricultural space nearby may want to consider subcontracting with local farm operators or nursery operators to set up yardwaste composting operations on land they own. The leaves would only need to be transported a short distance. This would work especially well for areas of the state that use a bulk system of pickup rather than bags of leaves. Farmers or nursery operators may already have the equipment needed for this type operation, such as front-end loaders to form and turn the windrows. For an investment of $10,000 to $40,000, a compost windrow turning machine that can be attached to a tractor may be purchased. This would enable a nursery operator or a farmer to supplement their income at a traditionally slow time of year. The finished compost product could then be utilized on the farm or nursery. In the case of farm operators the compost could be incorporated into the soil on the farm. This may be of particular interest to biological or sustainable farm operations in the state. Nursery operators could utilize the finished product on their field nursery crops, in potting mixes, etc. The municipalities involved in this type arrangement could save money on their tippage fees at the local landfills, and the farmer or nursery operator could have an additional source of revenue as well as the finished compost.

One potential problem may be the presence of non-biodegradable trash in the yardwaste such as aluminum cans, tree branches, rocks, etc. This may not be as much a problem for a farm or nursery operation where the finished product would be reincorporated into the soil on site as it would be if the finished product was going to be marketed. If the finished product was marketed, there would need to be a final screening of the material. Manual separation of some of the nonbiodegradable items in the yardwaste would have to be done by the municipal crews that picked up the material.

The amount of land needed for a small farm or nursery operation would be minimal also. Thirty percent of the nursery operators surveyed expressed an interest in having a facility on their site. They further indicated that they already had land and equipment such as front end loaders available for this type of an operation. The low or intermediate level technology would be most appropriate for farm or nursery based compost facilities that intend on using the material themselves. Intermediate level technology is recommended if the material is to be marketed.

2) The second type of facility is a medium sized private or municipally owned composting operation. This type of operation may be suitable for municipalities that may have open land available for a composting operation. Some of the costs incurred will be; 1) land for the site, 2) site improvements, 3) labor, 4) equipment, 5) buildings to house equipment and the labor force and 6) a water supply. A more centralized location for the facility will help reduce the transportation cost, but this may mean a higher land cost. A buffer zone is generally required because odors can be generated. An acre of land is needed for each 3,000 to 3,500 cubic yards of yardwaste. The site should have good drainage and access for cars or trucks for off loading yardwaste or picking up finished compost. In using a low level technology method, two side-by-side windrows are formed and, after the initial burst of microbial activity (approximately one month later), the windrows are combined into one. The windrows would then be turned in the late fall or winter and again in the spring and the following summer with the front-end loader or they could be turned based on internal temperature. After composting they would be moved to form curing piles at the edge of the site. This is done to provide space for bringing in the next years yardwaste. The curing piles could then be shredded and/or screened and made available for use to the public. Estimates of cost for this size of operation will vary according to tippage fees, the cost of land, the cost of the site improvements, the turning equipment involved, shredding and screening, etc. These costs are said to be a minimum of $4.00 per cubic yard for 1989 (Derr) and the maximum cost observed was $12.00 per cubic yard.

If intermediate level technology were to be employed, a windrow turning machine would be used. The largest cost component would then be for the windrow turning machine and the screening operation. Land would still account for a large portion of cost. Shredding is not necessary and the cost of a tub shredder or grinder could be eliminated if a windrow turning machine is utilized in the operation. The screening equipment that is needed only at the end of the process may be shared by nearby localities, since this step can be done over a several month period. A windrow turning machine could possibly be shared by several localities. At a minimum, a locality would need to own a front-end loader to form windrows.

The finished compost product could be used by the locality in landscaping programs or it could be picked up by local residents. Some of it could be sold to local landscapers, nursery operators, and state or local agencies.

3) The third type of composting operation is the large commercial composting operation. This type of operation would be best for municipalities that are highly developed where there would be difficulties in obtaining land at a reasonable cost for a compost operation. In this situation, yardwaste would have to be transported and composted several miles from the municipality and private commercial operators would be employed to handle the yardwaste. These sites would be relatively large facilities that could handle 80,000 cubic yards per year or more. An operation of this size would need to utilize an intermediate level of technology. These types of operations would also have to actively pursue a marketing program for the end product. This type operation is significantly more capital intensive. Some of the cost incurred would be the cost of land,

site preparation, equipment, cost for buildings to house personnel, and the cost of developing a marketing program.

The minimum equipment needed would be a front-end loader, windrow turning machine and a machine to screen the finished compost. A well managed operation in New Jersey, the Middlebush Composting facility, had a Scarab 18 windrow turning machine that was capable of handling a windrow 8 feet high x 18 feet wide, and could turn a row 125 feet long in 7 minutes or less. This was a well managed operation that turned out a superior end product. The finished compost was screened and sold to landscapers who could also opt to buy unscreened compost at a lower price. They had a marketing program and had no problem selling all of their finished product (at $10.00 per cubic yard for screened compost).

Derr (1989) discusses the diseconomies of scale in compost operations. That is, the large commercial operations have a higher cost per cubic yard to compost yard waste than a medium size facility and a small facility may have the lowest cost. This is because of the amount of equipment and personnel involved as scale increases. Also, a larger operation must have a marketing system which requires a year round facility as opposed to a farm or nursery operated facility that would be in operation primarily during the winter or early spring months. Of course once the marketing program was in place and all the finished products in the large commercial operation could be sold, additional revenues would be generated.

In summary, any composting operation is likely to require some capital cost and will have operating expenses. However, the advantages of extending the life of landfills, composting for less than tippage fees and producing a useful organic material in an environmentally acceptable manner appear to make composting the most efficient means of yardwaste management.

Role of The Private Sector in YardWaste Composting

As landfill costs rise all over the country, municipalities in search of ways of reducing waste management costs are looking towards composting yardwaste. To date, Florida, Illinois, Minnesota, New Jersey, Pennsylvania and Wisconsin have banned leaves and/or grass clipping from going to landfills and incinerators. As the movement toward utilization of yardwaste grows, the management methods are also changing. While some municipalities have the land, equipment and expertise to convert to a composting system, many do not. Increasingly, the private sector is seeing an opportunity to provide municipalities with yardwaste processing services. Based on survey results, 30% of the respondents in the Virginia Nursery Operators Survey expressed an interest in operating a compost facility if a satisfactory contract could be arranged with a locality. Over 70% of those interested have equipment such as tractors and front-end loaders available to form and turn the windrows. An equal number felt they have adequate land available for a compost operation. Nursery and landscape businesses are a natural market for compost, as much of the finished product could be used "in house" for potting soil mixes, field nursery crops, mulches and soil amendments for bedding plants and lawn establishment /renovation. In Seattle, Washington, for example, Pacific Topsoils, Inc. was contracted to accept yardwaste and market the final product. Also in the Pacific northwest, Portland, Oregon contracts its yardwaste to two well established firms, Grimm's Fuel and McFarlene's Bark, who processed more than 300,000 cubic yards of yardwaste in 1987 (Glenn,1989).

Others in the private sector that may be interested in managing compost operations would be farmers, who probably already have the land available and some type of equipment. As discussed in another section of this report, in Loudoun County, an environmental farmer is accepting land clearing debris to be composted and the finished product utilized on the farm for soil improvement. Other biological farmers may be interested in accepting leaves for composting and use on-farm.

Waste management companies are another area of the private sector that are becoming involved in yardwaste composting. Solid waste collectors view yardwaste processing as a means of reducing their tipping fees or as a way of expanding their services. In Davis, California, a private hauler, Davis Waste Removal, contracts with that city to provide a separate yardwaste collection service. The leaves are then composted and given back to the residents for their own use.

Private companies that provide management services to municipalities with yardwaste composting facilities are becoming more popular. For example, Organic Recycling, Inc., which currently services at least 11 municipal facilities in the northeast, provides the expertise to develop a system that will improve the facility's efficiency. Another company that offers similar services is Middlebush Compost, Inc. Middlebush started their own compost facility in 1987, and this well managed facility currently handles close to 100,000 cubic yards of leaves per year. In addition, they are interested in providing operating services at municipal sites.

In addition to the interested nursery operators in Virginia, this office has been contacted by several private concerns regarding different aspects of yardwaste composting in Virginia. It is apparent that the private sector is extremely interested in yardwaste composting and several firms are positioning themselves to establish medium to large facilities in the near future.

WOODY WASTE

According to survey information, approximately 11% of the total MSW in Virginia is woody materials, such as shrub and tree prunings, limbs and stumps. This number is lower than anticipated, and may not reflect the large quantity of material placed into debris landfills. Based on information from other states, woody waste may account for 15 to 20% of the total MSW in Virginia. Disposal of woody wastes currently consists of landfilling or burning. In most areas of the state, special debris landfills are used. Since woody materials decompose very slowly and have such a high C:N ratio, composting is impractical in most cases. However, this material can be reduced in size and used in soil mixes, as Resource Derived Fuel (RDF) or as mulch. Other possible future uses would be for processed wood products, such as particle board or as pulp.

In other areas of the country several innovative woody waste disposal operations that recover much of this material have been established. Pacific Topsoils in Everett, Washington, accepts woody wastes from landscapers and homeowners and grinds the material to a small chipped size using a 750 hp hammermill. The material is then screened and stockpiled to be later mixed with soil to produce a material marketed very successfully as topsoil. In another area of the operation, they process demolition debris and separate out the woody wastes to be used as RDF. The material is ground in a tub grinder and sent through a trommel screen to separate out the woody wastes from other materials such as rocks, metal and soil. A subsidiary company, Recovery Systems Technology,Inc. designs and builds equipment for recovering woody wastes as well as segregation and recovery of demolition wastes.

Zanker Resources in San Jose, California also accepts woody wastes from landscapers, land clearing operations and construction and demolition operations. They will not accept any treated or painted wood. Logs and stumps are piled separately from other waste. There is a large log splitter that will accommodate a log or stump up to twelve feet in diameter. The wood is split until it is small enough to be handled by several workers with chain saws. It is then cut into firewood and sold to the public at about one half the market price of other firewood. At another area of this operation, wood consisting of construction debris, pallets, land clearing wastes and yardwastes are ground and screened into different size fractions. The small chips are marketed as mulch, while the over-sized pieces are sold as RDF. Zanker Resources has also developed and patented a complete demolition waste recovery system.

In New Jersey, Alternate Disposal Systems, Inc. accepts land clearing, construction and demolition debris and woody yardwaste. They have designed a specialized grinder that is different than a hammermill or tub grinder. It has a set of free-spinning rollers with teeth and blades to impale and hold the wood. The wood is forced against the rollers as the central shaft holding the wood spins. This design makes it very difficult to jam the grinder. Also, some models can accommodate very large pieces of wood and reduce it to chips in a short time. The material then goes to a conveyer where the fine and intermediate sized materials are screened out and sold as a fine or coarse mulch. These mulch materials are sold as fast as they can be produced. The larger materials are either re-ground or sold as RDF. They also had a system for recovering soil from the stumps

and wood waste. A shaker is used to shake the soil loose from the wood and the soil is then sent to a pile of topsoil. This topsoil is very popular and is usually sold as fast as it can be made.

In Loudoun County, Virginia, Peter Knop, owner of Ticonderoga Farms, is evaluating an alternative technology for utilizing woody wastes. Mr. Knop has a Christmas tree operation in an area of Loudoun County that has very poor soils. He is experimenting with a method for adding organic matter to the soil in an effort to improve its physical condition. He is accepting land clearing debris and piling it in large windrows in areas of the farm with the worst soils. The windrows are irrigated and a viney cover (Wisteria) is being grown over the piles to conserve moisture. Ponds were dug below the piles to catch run-off. Mr. Knop believes the piles will break down in five years. The material will then be spread on the land around the piles to raise the soil organic matter content. Efforts have been made to minimize visibility of the windrows by placing them in isolated areas and maintaining a border of trees around the piles.

As discussed above, the primary uses of woody waste observed were as mulch or RDF. Virginia does not currently have a very good market for RDF so the majority of use would be as a mulch. However, the demand for mulch is currently filled through the use of various waste wood by products such as shredded bark. If landclearing debris and other woody waste were available, it would simply compete with other potential waste for a market share. This is further complicated by the fact that total demand for mulch materials appears to be less than half the volume that is potentially available if all woody waste were converted into mulch.

Some alternative uses of woody waste must be developed if these materials are to be removed from landfills. Future development of RDF facilities may help alleviate this problem in the future. However, the uncertainty in the RDF market makes it imperative that alternative uses of woody waste be developed. These materials are generally not considered suitable for use in pulping or manufactured wood products (pressboard, fiberboard, etc) because of foreign materials (soil, rocks, etc). Additional research is needed to determine the feasibility of making woody waste suitable for these uses or developing other innovative beneficial uses.

CONCLUSION - COMPOSTABLE YARDWASTE

Based on the findings of this study, it should be feasible to eliminate landfill disposal of all compostable yardwaste (leaves and grass clippings) by 1995. This can be accomplished primarily by composting at centralized facilities operated either by the public or private sector. In addition to composting, a reduction in the collection of yardwaste, particularly grass clippings, by home owners and land managers must be realized. The major obstacles that must be overcome to successfully implement a statewide program include: lack of public and governmental awareness, inadequate demand to meet supply, inadequate understanding of composting technologies by local and state officials, complex regulatory requirements, and cost of establishing compost facilities. If the recommended programs and actions are followed, these obstacles can be overcome and a successful program implemented by 1995.

CONCLUSION - WOODY WASTE

Based on the findings of this study, inadequate demand will continue to limit the potential for recycling woody waste until new technologies and/or alternative uses can be developed. However, since woody waste represents a substantial portion of the waste stream, the state should support efforts to identify new technologies and uses to recycle woody waste as identified in the recommendations of this report.

RECOMMENDATIONS
Yardwaste

Recommendation 1: Prohibit the placement of leaves and grass clippings in landfills by 1995.

Explanation: Leaves and grass clippings constitute 5 to 40% of MSW (estimated average of 15 to 20%). Through the establishment of yardwaste composting facilities concurrent with a strong public education program on yardwaste management and alternative grass clipping disposal, these materials can be managed without landfilling. The 1995 date allows time for pilot, demonstration and public education programs to be completed and for localities and private business to establish yardwaste composting facilities. Based on this study, yardwaste can be composted at a lower cost than the current average tippage fee ($19.63/ton) which is expected to rise dramatically. Therefore, removing yardwaste from landfills will save localities money. However, initial capital costs may negatively impact some localities choosing to operate a facility. Those localities may be able to obtain assistance through the Virginia Resources Authority. Prohibitions on yardwaste in landfills have already been implemented in several states and are being considered by many others.

Recommended Action: Amend the solid waste management statutes to prohibit the placement of leaves or grass clippings in landfills after January 1, 1995.

Recommendation 2: Provision of low interest loans and/or tax incentives for establishment of private yardwaste compost facilities.

Explanation: Capital costs associated with the establishment of a compost facility are substantial. A portion of the benefits accrued from the facility are shared by local and state government through reduced solid waste volumes. To reduce the impact of capital cost and provide incentive for private sector involvement, it would be beneficial to either establish a low interest loan fund or reduce state taxes for compost facilities.

Recommended Action: Reduction in state tax rate or establishment of a low interest loan fund for yardwaste compost facilities.

Recommendation 3: Establish clear and simple regulatory procedures for compost facilities accepting yardwaste only or yardwaste mixed with solid animal wastes.

Explanation: Yardwaste compost sites are currently regulated under Section 6.1 of the Solid Waste Management Regulations. This section was designed for composting of refuse or combinations of refuse and sludge. The siting, design, construction and operational requirements are comparable to those for landfills or sewage sludge

composting facilities. This necessitates a detailed application (including a Part B Solid Waste Management Facility application); waste, air and groundwater monitoring; leachate and runoff control; all-weather impermeable pads, and numerous other requirements. Some states have exempted yardwaste composting sites from solid waste management regulations and established a more simple approval process with less stringent requirements. In Minnesota, this consists of a two page form letter requesting approval which is reviewed and returned with a letter of approval (if deemed acceptable) within two weeks of receiving the application. If Virginia is to implement a statewide yardwaste composting program, a simpler approach to permitting or approval must be developed.

Recommended Action: That either the Solid Waste Management statutes or regulations be amended to exempt yardwaste only or yardwaste and solid animal waste compost facilities from the requirements of Section 6.1 of the Solid Waste Management Regulations. Further, that a letter approval procedure be established within DWM to facilitate siting of such compost facilities. These changes should be implemented as soon as possible.

Recommendation 4: Establishment of a three year pilot program at six locations around Virginia (FY91, 92, 93).

Explanation: Different composting technologies are applicable depending on quantity of yardwaste, available land area, potential markets and users, availability of equipment and other factors. In addition, various mixes of grass clippings or other high nitrogen wastes result in different composting conditions and compost quality. It is critical that a pilot program with an associated educational program be conducted to familiarize state and local government officials and the private sector about available technologies and options for mixing leaves with grass clippings or other wastes. Further refinement in technologies will likely be necessary under Virginia conditions and regulations. The pilot program will allow evaluation and refinement of technologies. The pilot program will also allow for development of a data base on the chemical composition of various types of finished compost since very limited data is available in the literature. Finally, the pilot program will provide finished compost from various technologies that can be evaluated by users for suitability and used in local demonstration programs as well as those in Recommendation 5.

Recommended Action: Appropriation of $120,000 in FY91, $65,000 in FY92 and $65,000 in FY93 to DWM. The Department will contract with appropriate individuals in VCES to assist in the conduct of the pilot program. The localities for the pilot programs will be selected by a joint committee from DWM and VCES based on interest expressed during this study and geographic diversity.

Recommendation 5: Establishment of a demonstration and public education program on uses of finished compost at 10 additional locations (FY92, 93).

Explanation: For the statewide yardwaste composting program to succeed, major increases in market demand for the finished product will be required. By having demonstration areas at parks, municipal buildings, etc. and conducting field days at the demonstration sites, users will gain confidence in the suitability of the materials. Secondly, publications need to be developed and distributed on the material and on the appropriate ways to use it.

Recommended Action: Appropriation of $40,000 to the DWM in FY92 and in FY93. A joint committee from DWM and VCES will award extension agents in 10 localities (not part of pilot program) grants of $2,000 per year to establish a yardwaste utilization demonstration program. The localities will be selected based on merit of the proposed program and geographic diversity. Each locality will be required to conduct field days open to representatives from adjacent localities. The remaining $20,000 each year will be awarded to appropriate individuals in VCES to develop publications on the use of composted yardwaste.

Recommendation 6: Establishment of a public education program on backyard composting (FY91, 92).

Explanation: Backyard composting not only results in savings in landfill space but also eliminates the very high cost of collection of yardwaste and other compostable solid waste. There appears to be significant potential to increase the number of homeowners who backyard compost through a public education program. Because of savings by not collecting and handling the waste as well as savings in landfill space, savings from even modest increases in backyard composting may be substantial.

Recommended Action: Appropriation of $30,000 per year for FY91 and 92 to DWM. These funds will be awarded on a competitive basis for the conduct of a two year public education program. Proposals will be evaluated on merit but must include publications, media exposure and demonstrations.

Recommendation 7: Establishment of a program on alternative management of grass clippings (FY91, 92).

Explanation: Grass clippings usually amount to the same annual volume of solid waste as leaves. However, they should be mixed at a ratio of about three parts leaves to one part grass clippings. This is further complicated by the fact that fall and spring leaves are partially composted by the time grass clippings are collected. Thus, successfully composting grass clippings, at current volumes, would be extremely difficult. Research has shown that, with frequent mowing, grass clippings do not need to be removed. It is critical that the public be educated on alternative clipping management prior to implementation of Recommendations 1 and 9.

Recommended Action: Appropriation of $30,000 per year for FY91 and 92 to DWM. These funds will be awarded on a competitive basis for the conduct of a two year public education program. Proposals will be evaluated on merit but must include publications, media exposure and demonstrations.

Recommendation 8: Development of a Yardwaste Composting Manual for Virginia (FY91).

Explanation: If a statewide program is to be implemented, every locality and/or private composter will need to know how to plan, design and operate a compost facility. In addition, they must understand the potential uses and market opportunities for the finished compost. Many states that have mandatory composting requirements have, or are developing, composting manuals. Due to differences in regulations, climate, soils and yardwaste composition, it is important that Virginia have a composting manual.

Recommended Action: Appropriation of $25,000 for FY91 to DWM. These funds would be used to contract for the development of a yardwaste composting manual. The manual should include discussions of technologies, costs, uses and regulatory requirements.

Recommendation 9: Encourage localities to restrict collection of grass clippings either bagged or bulk.

Explanation: Grass clippings are extremely difficult to compost unless mixed with large quantities of leaves or other bulking agents. Grass clippings are the primary generator of odors at yardwaste compost facilities. Currently, the timing of collection and volume of clippings do not allow the proper blend of leaves and clippings for composting. With proper frequency of mowing, grass clippings do not need to be removed. Further, homeowners desiring to remove clippings can use an alternative management technique such as backyard composting. If yardwaste composting is to be successful, the volume of collected grass clippings must be greatly reduced. A complete ban on collection of grass clippings may provide the only mechanism to adequately reduce clipping volumes in some locations.

Recommended Action: The DWM and VCES work with local governments to develop model ordinances, local education programs and implementation plans for discontinuing the acceptance of grass clippings at landfills.

Recommendation 10: Minimize regulatory requirements for farmers and nursery operators managing compost facilities accepting less than 5000 cubic yards of yardwaste only per year and using all the finished compost in their own farming or nursery operation.

Explanation: Potential environmental contamination from small yardwaste composting sites is minimal. In several states small compost facilities are exempted from most regulations. This could be particularly important for smaller municipalities who may find it more difficult to successfully operate a full scale compost operation. Minimizing regulatory requirements for small scale composters who will use the end product in their own operation will provide incentives and cost reductions to them. This will help assure that composting facilities will be available for smaller municipalities. Further it will assure private sector involvement and provide additional income to farmers (and nursery operators) who may need the additional revenues to remain in business.

Recommended Action: Change the Solid Waste Management Regulations to exempt farmers and nursery operators who accept for composting less than 5000 cubic yards per year of yardwaste only from the yardwaste compost regulations. However, require such operators to notify DWM of their intent to operate a facility and its location. In addition, the operator shall submit an annual report on the volume and types of yardwaste accepted and a statement certifying that only yardwaste was accepted for composting.

Recommendation 11: Require state government and encourage local government to use yardwaste compost.

Explanation: For the statewide yardwaste composting program to succeed, the potential market volume of compost must be increased. State and local governments through needs for highways, parks and institutional grounds may be the largest potential users of composted yardwaste. If all public sector demand for comparable organic materials was supplied by yardwaste, it is likely that all demand problems would be alleviated.

Recommended Action: 1) That the Governor issue an executive order to all state agencies requiring the use of composted yardwaste in place of other organic materials when available, competitively priced and of acceptable quality for all state contracts and bids. That this order go into effect January 1, 1991.

2) That DWM and VCES work with local governments to develop model ordinances requiring local agencies and departments to use or require the use of locally available composted yardwaste where appropriate.

RECOMMENDATIONS

Woody Waste

Recommendation 1: Evaluate what changes in practices or new technologies are needed to allow use of woody waste in manufactured wood products and pulping operations.

Explanation: There is currently inadequate demand for woody waste as mulch and the market for mulch is already dominated by wood by-products such as shredded bark. Thus alternative uses of woody waste must be developed. Woody waste is currently considered too "dirty" for use in manufactured wood products or pulping operations. However, if the large volume of woody waste is to be recycled, technologies to allow its use in these processes must be developed.

Recommended Action: 1.) Appropriate $25,000 to DWM in FY91 to fund a state of the art project on alternative uses of woody waste to determine technologic limitations on potential alternative uses of woody waste.

2.) Appropriate $100,000 per year to DWM for FY92, 93, 94 to fund research and pilot programs on technologies to make woody waste acceptable for manufactured wood products or pulping. Projects should be awarded on a competitive basis and no one project should exceed $40,000 per year. The types of research funded should be based on the state of the art project results.

Recommendation 2: Determine the market potential for chipped woody waste as a Resource Derived Fuel (RDF).

Explanation: There currently appears to be a limited market for RDF in Virginia. However, observations of activities other states indicate this may be an important future market for woody waste.

Recommendation Action: Appropriate $25,000 to DWM in FY91 to fund a study on the current and future potential market for woody waste as RDF. The study should also identify any factors that may limit the suitability of woody waste as RDF and recommend research or application of existing technologies to overcome such limitations.

Recommendation 3: Evaluate the feasibility of long term decomposition of woody waste with subsequent utilization as a soil amendment.

Explanation: A private firm in Virginia is currently conducting a study to determine the feasibility of windrowing land clearing debris, prunings, and soil and allowing long term decomposition of the wood. Decomposition is accelerated by growing a viney cover over the windrow, irrigating to maintain moisture and inoculating with decomposing fungus.

Care is taken in placement of the windrows to minimize their visibility and to limit the number based on the amount of material needed to cover a field area with finished decomposed materials. It is anticipated that decomposition will take five to ten years. Although this is an unproven technology, it may have practical application when limits on windrow location and density are required.

Recommended Action: That DWM and VCES closely observe the pilot program and that DWM determine the applicability of this technology including needed restrictions and monitoring.

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APPENDIX A. Contacts for Site-Visit Locations and Out of State Telephone Interviews.

SITE VISIT CONTACTS

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DEPT. OF ENV. PROTECTION
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Ron Scholz
California Dept of Conservation
Sacremento, CA
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APPENDIX B. Surveys Sent to Nursery Operators, Extension Agents and Landfill Managers.

COLLEGE OF AGRICULTURE AND LIFE SCIENCES

VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY

Blacksburg, Virginia 24061-0404

DEPARTMENT OF CROP AND SOIL ENVIRONMENTAL SCIENCES

425 Smyth Hall

July 17, 1989

TO: Virginia Nursery Operators

FROM: T. W. Simpson, Associate Professor,
Soil-Environmental Quality
Jim May, Graduate Research Assistant, Horticulture

We are currently conducting a feasibility study for the Virginia Department of Waste Management at the request of the General Assembly on the potential for large scale composting of yard waste (primarily leaves and grass clippings). Currently much of this material is collected and buried in landfills using valuable landfill space. Work done in other states has shown that these materials can be composted into a low nutrient value compost with physical properties similar to peat or composted sewage sludge. The material will be made from leaves with some grass clippings or a higher nitrogen organic waste (such as poultry litter) added to increase composting rate and nutrient content. In some states, localities have contracted with private sector businesses (such as nurseries) to do the composting operation. The contract fee is sufficient to provide a profit to the compost operation but is generally lower than the cost to landfill the yard waste. The composter then has the finished material to use or market.

Our study will help determine both the feasibility of making the compost and of developing uses or markets. We are also interested in assessing private sector involvement in both the composting and marketing of the materials. As a nursery operator, you are potentially a user, wholesaler and/or retailer of the material and you may have the interest and means to develop a compost site.

We need to know your opinions on yard waste composting and potential uses for the material. Please answer the questionnaire on the following pages and return it to us in the enclosed self addressed, stamped envelope. All answers will be strictly confidential. It should take you less than 15 minutes. The results will enable us to recommend to the General Assembly a sound yard waste composting program that will save Virginia localities millions of dollars. It will also provide you an opportunity to learn more about a product that may save you money and/or provide a profitable addition to your business.

We thank you in advance for your assistance with this project.

TWS/lap

SURVEY OF
NURSERY OPERATORS CONCERNING YARD WASTE
COMPOST PRODUCTION AND UTILIZATION
JULY 1989

Part A. Current use of compost-like materials

1. Is your nursery operation: a) wholesale b) retail c) rewholesale

2. Please check below all the types of organic matter sources you use and estimate the volume you use per year.

Material	Annual Use Estimate (cubic yards)	Material	Annual Use Estimate (cubic yards)
___ a) peat moss	_____	___ e) aged sawdust	_____
___ b) sludge compost	_____	___ f) shredded bark	_____
___ c) manure compost	_____	___ g) commercial potting mix	_____
___ d) leaf compost	_____	___ h) other (identify)	_____

3. Check below all the ways in which you use the materials from 1 above and estimate your use volume.

Use	Annual Use Estimate (cubic yards)	Use	Annual Use Estimate (cubic yards)
___ a) potting mix	_____	___ d) hydroseeding	_____
___ b) field nursery crops	_____	___ e) lawn establishment/ renovation	_____
___ c) mulches	_____	___ f) other (identify)	_____

Part B. Sale of compost-like materials.

1. What types of organic materials do you offer for sale? (If none, go to Part C)

Material	Estimated Annual Sales Volume (cubic yards)	Material	Estimated Annual Sales Volume (cubic yards)
___ a) peat moss	_____	e) aged sawdust	_____
___ b) sludge compost	_____	f) shredded bark	_____
___ c) manure compost	_____	g) commercial potting mix	_____
___ d) leaf compost	_____	h) other (identify)	_____

2. By your own best estimate, rank the list below from most common (1) to least common (6 or 7) customer use of the materials in question 1.

___ a) potting mix
___ b) nutrient source
___ c) mulches
___ d) home garden soil amendment
___ e) lawn establishment/ renovation
___ f) other (identify)

rt C. Uses of coarse mulching materials

1. If you sell coarse mulching materials, check all types below that you sell and estimate the volume of sales for each material.

	Annual sales volume (cubic yards)		Annual sales volume (cubic yards)
___ a) wood chips	_____	___ e) decorative stone mulch	_____
___ b) bark - pine chips	_____	___ f) pine straw	_____
___ c) bark - hardwood	_____	___ g) other	_____
___ d) bark - shredded	_____		

Part D. Interest in using or selling composted yard waste.

1. Would you be interested in using composted yard waste, if the price is well below that of comparable material and it can be delivered in bulk to your nursery?

   ___ a) yes ___ b) no

2. Would you be willing to go to a compost site within 30 miles of your nursery to obtain bulk quantities of compost, if the cost, including transport, was less than that of comparable materials.

   ___ a) yes ___ b) no

3. For which of the following uses could you substitute compost for your current organic matter source. (Check all that apply)

   ___ 1. potting mix
   ___ 2. field nursery crops
   ___ 3. mulches
   ___ 4. hydroseeding
   ___ 5. lawn establishment/ renovation
   ___ 6. other (identify)

4. Assuming it can be sold at a profit, would you be interested in selling bulk quantities of composted yard waste and, if so, what do you estimate your annual sales volume to be.

   ___ a) yes - Volume Estimate _____yds. ___ b) No

5. If available, would you be interested in selling bagged or baled composted yard waste and, if so, what do you estimate your annual sales volume to be.

   ___ a) yes - Volume Estimate _____yds. ___ b) No

6. Would you be interested in obtaining bulk quantities of compost and having your own bagging or baling operation?

   ___ a) yes, bagging for your retail sales only
   ___ b) yes, bagging for wholesale distribution and retail sales
   ___ c) yes, baling for wholesale distribution and retail sales
   ___ d) no

Part E. Interest in composting, distributing and marketing yard waste.

1. Would you be interested in operating a compost facility, if a satisfactory contract could be made with a locality?

   ___ a) yes ___ b) no (go to Part F)

2. Generally 2 to 5 acres are needed for a compost site. Do you currently have land that could be used as a compost site?

   ___ a) yes ___ b) no

3. Do you have tractors with front-end loaders or other means of mixing and turning the compost?

   ___ a) yes ___ b) no

4. Capital costs in the range of $25,000 to $100,000 may be needed to start a compost facility. Would the availability of low interest loans from the state and/or a tax credit program be of interest to you to help reduce the impact of start-up costs?

   ___ a) yes ___ b) no ___ c) maybe

5. Yard waste composting will probably be regulated which will necessitate some monitoring and record keeping. Even if the operation could still be profitable, would the amount of regulatory activity influence your interest in operating a yard waste composting facility?

   ___ a) yes ___ b) no ___ c) maybe (to a limited extent)

Part F. Do you want further information? (optional)

1. Would you be interested in being placed on a mailing list at Virginia Tech to receive additional information about yard waste compost/composting as it becomes available?

   ___ a) yes Name:_____
   Address:_____
   City/Town:_____
   Zip:_____

   (This information will be blacked out as soon as we add it to our mailing list and will not be readable when responses to survey questions are compiled.)

   ___ b) no **(Thanks for completing the survey)**

2. If you answered yes to question 1, in what aspects of yard waste compost/composting are you interested (check all that interest you)?

   ___ a) wholesaling or retailing compost
   ___ b) bagging or baling and distributing compost
   ___ c) using compost in your nursery operation
   ___ d) operating a compost facility
   (Thanks for completing the survey)

COLLEGE OF AGRICULTURE AND LIFE SCIENCE

VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY

Blacksburg, Virginia 24061-040

DEPARTMENT OF CROP AND SOIL ENVIRONMENTAL SCIENCES

425 Smyth Hall

July 28, 1989

TO: Virginia Landfill Managers

FROM: T. W. Simpson, Associate Professor,
Soil-Environmental Quality
Jim May, Graduate Research Assistant, Horticulture

We are currently conducting a feasibility study for the Virginia Department of Waste Management at the request of the General Assembly on the potential for a statewide composting program for yard waste (primarily leaves and grass clippings). As you know much of this material is being landfilled in Virginia. Work done in other states has shown that these materials can be composted into a low nutrient value material similar to composted sewage sludge. With the extreme pressures on landfill space and mandatory source reductions, composting of yard waste may offer important money and space savings.

Our study will help determine both the feasibility of making the compost and of developing uses or markets. We are also interested in assessing private sector involvement in both the composting and marketing of the materials. As a manager of a municipal solid waste landfill, you can provide us with essential information concerning yard waste collection in your locality and your opinions on the potential for composting these materials.

Please answer the questionnaire on the following pages and return it to us in the enclosed self addressed, stamped envelope. All answers will be strictly confidential. We will only compile and present information at the planning district or larger geographic area. If you would like a copy of the results of this study, be sure to fill in the information at the end of the survey. It should take you less than 15 minutes to complete. The results will enable us to recommend to the General Assembly a sound yard waste composting program that will save Virginia localities tens of millions of dollars. It will also provide you an opportunity to learn more about a process that may save you money and landfill space.

We thank you in advance for your assistance with this project.

TWS/lap

SURVEY OF MUNICIPAL SOLID WASTE LANDFILL MANAGERS CONCERNING YARD WASTE COLLECTION AND DISPOSAL JULY 1989

Selection A. Geographic Location

1) Name or number of planning district _____
(For geographic location only)

Section B. Landfill Information

1) Ownership of landfill in which your solid waste is disposed
   a. Publicly owned and operated
   b. Publicly owned and privately operated
   c. Privately owned and operated

2) Projected life of current landfill in years (circle one)
   1 2 3 4 5 6 7 8 9 10 to 15 16 to 20 more than 20

3) If projected life of landfill is less than ten years, circle any of the steps below that have been taken towards replacement of current landfill.
   a. Planning committee/group formed
   b. Siting activities begun
   c. Site selected
   d. Design work begun
   e. Design completed
   f. Landfill construction begun
   g. Landfill completed, ready for use
   h. No current activities

4) A. Amount of municipal solid waste handled per week? (Circle one) based on 5 day week or 7 day week?)

   a. 0-10 tons
   b. 10-25 tons
   c. 25-50 tons
   d. 50-100 tons
   e. 100-250 tons
   f. 250-500 tons
   g. 500-750 tons
   h. 750-1000 tons
   i. 1000-1250 tons
   j. 1250-1500 tons
   k. more than 1500 tons

5) The standard tippage fee is $_____ per ton or
   $_____ per yard or
   $_____ per truck or
   $_____ other method (describe)

6) Percent of municipal solid waste that is:

Landfilled	a.	0-25%	b.	25-50%	c.	50-75%	d.	75-100%
Incinerated	a.	0-25%	b.	25-50%	c.	50-75%	d.	75-100%
Composted	a.	0-10%	b.	10-25%	c.	25-50%	d.	50-100%
Recycled	a.	0-10%	b.	10-25%	c.	25-50%	d.	50-100%

Section C. Organic Yard Waste Information

1) A. What percent of total municipal solid waste do you estimate to be organic yard waste? (Leaves, grass clippings, shrub and tree prunings - do not include stumps and tree trunks)

Jan-Mar	Apr-Jun	July-Sept	Oct-Dec	% of Total Annual Solid Waste
a. 0-5%	a. 0-5%	a. 0-5%	a. 0-5%	a. 0-5%
b. 5-10%	b. 5-10%	b. 5-10%	b. 5-10%	b. 5-10%
c. 10-15%	c. 10-15%	c. 10-15%	c. 10-15%	c. 10-15%
d. 15-20%	d. 15-20%	d. 15-20%	d. 15-20%	d. 15-20%
e. over 20%	e. over 20%	e. over 20%	e. over 20%	e. over 20%

B. Estimate the percentage of the total yard waste that is:
1) leaves _____%
2) grass clippings _____%
3) shrub and tree prunings _____%

2) What percent of your total municipal solid waste do you estimate to be stumps, limbs and other land clearing waste?
a. 0-5% b. 5-10% c. 10-15% d. 15-25% e. 25-35% f. 35% or more

3A) Do you have a curbside collection program for leaves? a) Yes b) No
Collection period (months) _____

3B) How do you currently dispose of leaves?
a. landfill
b. stockpile on county lands
c. give-a-way program (please estimate % of leaves collected that are used _____)
d. composting (please estimate % of collected leaves that are composted _____)
e. other (please describe)

4A) Do you have curbside collection of grass clippings or shrub prunings?
a. Yes b. No

4A) Do you allow bulk disposal of grass clippings or shrub prunings? a) yes b) no

4B) If yes, how do you dispose of clipping and pruning wastes?
a. landfill
b. stockpile on county lands
c. composting (please estimate % of clippings that are composted _____)
d. other (please describe)

Section D Composting Feasibility

1) Are you aware of the use of composting systems for recycling organic yard wastes in some other states?
a. Yes b. No

2) Have you established a group to study alternative uses for yard waste (such as composting)?
a. Yes - (Optional: Contact Person _____ Phone _____)
b. No

3) What is your perception of the feasibility of yard waste composting in your locality? (Circle one)
a. unlikely b. possibly c. likely d. very likely
Comments _____

4) Do you think your local government would pay a private yard waste facility a fee that is less than your tippage fee to take your yard waste on a contractual basis?
a. Yes b. No

5) What are/would be the most likely uses for compost in your locality.
a. Parks and golf courses
b. Community landscaping
c. Make available to public
d. Sell to private landscapers, nurserys, etc.
e. Others (please describe)_____

6) Do you think there is public land available for a compost facility? (estimated need is minimum of 2 acres or about 5 acres per 20,000 yards of yard waste)
a. Yes b. No

Section E Request for Study - Results

1) Would you be interested in receiving a copy of the final results of this study?

a. Yes

Name _____
Title _____
Address _____
Phone _____

(This information will be blacked out as soon as we add it to our mailing list and will not be readable when responses to survey questions are compiled)

b. No

THANK YOU FOR YOUR ASSISTANCE!!

VIRGINIA COOPERATIVE EXTENSION SERVICE

VIRGINIA TECH

VIRGINIA STATE

DEPARTMENT OF CROP AND SOIL ENVIRONMENTAL SCIENCES
424 SMYTH HALL
BLACKSBURG, VA 24061-0403

July 28, 1989

TO: Extension Agents-Agriculture

FROM: T. W. Simpson, Associate Professor,
Extension Soil Scientist
Jim May, Graduate Research Assistant, Horticulture

RE: Yard Waste Compost/Composting Survey

We are currently conducting a feasibility study for the Virginia Department of Waste Management at the request of the General Assembly on the potential for large scale composting of yard waste (primarily leaves and grass clippings). Much of this material is collected and buried in landfills using landfill space. Work done in other states has shown that these materials can be composted into a low nutrient value peat-like material similar to composted sewage sludge, cow manure, etc.

Our study will help determine both the feasibility of making the compost and of developing uses or markets. We are also interested in assessing private sector involvement in both the composting and marketing of the materials.

We need to know your opinions on yard waste composting and potential uses for the material. Please answer the questionnaire on the following pages. It should take you less than 15 minutes. The results will enable us to recommend to the General Assembly a sound yard waste composting program that may save Virginia localities tens of millions of dollars. It will also provide you an opportunity to learn more about an activity that may save your county money, substantially reduce landfill space needs, and provide a compost product for commercial and home use.

We thank you in advance for your assistance with this project.

TWS/lap

Extension Agent Survey on Yard Waste Compost/Composting

Part A. Demographics and Contact Information

1. Name of City/County _____
2. Name of Agent Responding _____
3. Population of City/County _____.
4. Which of the following would you say best describes your city/county?

___ a) urban
___ b) urban-suburban
___ c) suburban
___ d) suburban-rural
___ e) rural-suburban
___ f) rural

Part B. Estimates of current yard waste management, uses and disposal practices.

1. If your city/county has a leaf collection program, what is done with the leaves?
___ a) landfilled
___ b) composted
___ c) stockpiled
___ d) give away program
___ e) other

2. If your locality has a give away program, estimate the percent of total collected leaves that are used (removed from central site) each year.
___ a) < 10%
___ b) 10-25%
___ c) 25-50%
___ d) 50-75%
___ e) 75-90%
___ f) 90-100%

3. Does your locality allow bulk disposal of grass clippings at the landfill?

___ a) yes
___ b) no

4. What percent of your households do you think remove grass clippings from their lawns?
___ a) 0-10%
___ b) 10-25%
___ c) 25-50%
___ d) 50-75%
___ e) 75-100%

5. For households that remove clippings, rank the following list for what you think to be the most common (identify as 1) to the least common (identify as 6) means of disposing of clippings.
___ a) bag for regular garbage collection
___ b) bulk transport to landfill
___ c) backyard/woodland stockpile
___ d) use in backyard composting
___ e) mulch garden
___ f) mulch ornamentals

6. Rank the following list for what you perceive to be the most common (1) to the least common (5) means of disposing of pruning materials from woody ornamentals.

___ a) bag for regular garbage collection
___ b) bulk transport to landfill
___ c) backyard/woodland stockpile
___ d) chip and use as mulch
___ e) burn

7. What percent of the households in your locality do you estimate to have a backyard compost bin/pile?

___ a) 0-10%
___ b) 10-20%
___ c) 20-30%
___ d) 30-40%
___ e) 40-50%
___ f) more than 50%

Part C City/County Interest in Yard Waste Composting

1. Are you aware of any interest/plans by your locality to initiate recycling programs for yard waste?

___ a) no
___ b) yes - some interest/discussion
___ c) yes - committee formed to study
___ d) yes - plans being formed
___ e) yes - plan in place
___ f) yes - recycling/composting program in operation

2. If you answered yes (in any form) to question one, what types of yard waste recycling programs do you perceive/know to be likely for your locality? (check all that apply)

___ a) leaf giveaway
___ b) leaf composting
___ c) grass clipping composting/ co-composting with leaves
___ d) chipping woody materials
___ e) other (identify)

Part D Interest in using composted yard waste

1. Rank the following lists from what you think to be the most likely use to the least likely use for a good quality leaf and/or grass compost material in your locality.

a) Based on your expertise and experience, rank the following list from most appropriate (1) to least appropriate (9 or 10) use of composted yard waste.

___ home garden mulch
___ ornamental/flower mulch/bedding
___ landfill revegetation
___ potting mix
___ roadside revegetation
___ lawn establishment/renovation
___ mulches
___ organic nutrient source
___ home garden soil amendment
___ other (identify) _____

b) Uses by homeowners (Rank from most (1) to least (6) likely use).

___ ornamental mulch
___ garden mulch
___ garden soil amendment
___ lawn establishment/renovation
___ organic nutrient source
___ bedding material/mix

c) Uses by nurseries/landscapers. (Rank from most (1) to least (7) likely use)

___ potting mix
___ mulch
___ field nursery crops
___ lawn establishment/renovation
___ hydroseeding
___ organic nutrient source

d) Uses by local government/institutions

1. County departments that may use compost (Rank from most (1) to least (5 or 6) likely to use compost).

___ Parks and Recreation
___ Buildings and Grounds
___ Public Schools
___ Roads and Streets
___ Landfill Management
___ other (identify) _____

2. Type of uses (Rank the types of uses by local government from most (1) to least (6 or 7) likely.)

___ landfill revegetation
___ flower/ornamental bedding mulch
___ potting mix
___ roadside revegetation
___ fertilizer source
___ lawn establishment/renovation
___ other _____

e) Uses by farmers (5 or more acres in production of agronomic, vegetable or fruit crops). Rank from most likely (1) to least likely (6 or 7) use.

___ organic nutrient source
___ soil physical conditioner-agronomic
___ soil physical conditioner-vegetable
___ mulch - vegetable
___ mulch - small fruit
___ soil physical conditioner-fruit
___ other

Part E Potential for Privatization of Yard Waste Composting

1. Do you think your city/county would be interested in contracting with a private firm to accept and compost bulk collected leaves and grass clippings for a fee less than your landfill tippage fee.

a) Yes b) No

2. Rank your perception of the interest of the following business people in running a yard waste composting operation. Assume a profit generating contract can be developed with your locality (Rank from most interest (1) to least interest (7 or 8).

___ nursery operator
___ greenhouse operator
___ landscaping firm
___ waste management firm
___ farmer
___ farm and garden supply
___ biological farmer/supplier
___ other _____

Part F. Use volume and need for educational program

1. Do you think that there exists adequate demand to use all yard waste compost that would be generated from collected leaves and grass clippings in your locality. At this time, assume a giveaway program at a central site.

   ___ a. more demand that supply
   ___ b. adequate demand for supply
   ___ c. somewhat less demand than supply
   ___ d. much less demand than supply
   ___ e. almost no demand compared to supply

2. Rank each of the following areas relative to the need for an educational program before a successful yard waste recycling (and source reduction) program can be implemented (Rank need as High (H), Medium (M), Low (L), Unimportant (U).

   ___ a. educate local government on composting and other recycling technologies
   ___ b. educate private sector on composting technologies, regulations and business opportunities
   ___ c. educate farmers on possible uses
   ___ d. educate landscapers on uses
   ___ e. educate homeowners on uses
   ___ f. educate homeowners on proper handling of yard waste to facilitate collection and composting
   ___ g. educate homeowners to not remove grass clippings
   ___ h. educate homeowners on backyard composting

3. For those items in question 2 that you ranked as high, what types of activities and materials do you feel would be most helpful in the public education program. Rank the need for this type of activity as high (H), medium (M) or low (L). (Check all that apply)

   ___ ___ a. demonstrations/pilot programs on large scale composting
   ___ ___ b. seminars/workshops for government officials
   ___ ___ c. publications on composting technologies
   ___ ___ d. brochures for homeowners
   ___ ___ e. radio and television spots
   ___ ___ f. press releases/newspaper articles
   ___ ___ g. video tapes
   ___ ___ h. demonstrations on compost use
   ___ ___ i. field days at demonstration sites
   ___ ___ j. slide sets
   ___ ___ k. teleconferences
   ___ ___ l. presentations to nursery assoc., landscapers, etc.

4. If pilot/demonstration sites and other educational programs are established, would you and your city or county like to be considered as a location of one of the pilot programs (a positive response does not obligate either you or me).

   ___ a. yes
   ___ b. probably
   ___ c. maybe
   ___ d. no

Thanks for Your Assistance!!

APPENDIX C. Potential User Groups of Yardwaste Compost and Specific Potential Users in the Nursery Industry.

Yardwaste Compost

User Groups

1. Nursery Operators
2. Landscapers
3. Biological/Sustainable Farmers
4. Commercial Grounds Managers
5. County Building and Grounds Departments
6. County Parks and Recreaction Departments
7. Landfill Managers
8. Turfgrass Producers
9. Virginia Department of Transportation
10. Virginia Department of Conservation and Recreation
11. Homeowners, Gardeners
12. State Land/Grounds Managers

An Example of Specific Potential Users (All Registered Nursery Operators in Virginia-address, number of acres in nursery and city/county where located)

- * -

Loudoun Nursery, Inc.
Route 1, Box 346
Hamilton VA 22068
45
Loudoun

- * -

Great Big Greenhouse & Nursery
3435 Western Branch Boulevard
Chesapeake VA 23321
1
Chesapeake

- * -

Bowen & Young
J & J Treeland
Route 1, Box 251
Cumberland VA 23040
30
Cumberland

- * -

Keswal, Inc.
Greenspire Nursery
Route 2, Box 131
Christiansburg VA 24073
1
Montgomery

- * -

J.C. Ackerman
Blue Ridge Botanicals
RD 1, Box 318 A
Bluemont VA 22012
1
Loudoun

- * -

Arthur W. Allison
1719 Avondale Avenue
Richmond VA 23227
1
Hanover

- * -

Eddie Anderson
McDonald Nurseries, Inc.
1139 W. Pembroke Ave.
Hampton VA 23361
6
Hampton

- * -

J.T. Clevengers Nursery
HC38 Box 126
Winchester VA 22601
1
Frederick

- * -

Middletown Nurseries
Box 337
Melfa VA 23410
500
Accomack

- * -

F.C. & G, Inc.
Great Big Greenhouse & Nursery
1276 Great Neck Road
Virginia Beach VA 23664
5
Hampton

- * -

Monroe & Morris
Grandview Nursery
24 Canal Road
Hampton VA 23664
5
Hampton

- * -

Julian R. Adams
Adams Bonsai
4628 Locksview Road
Lynchburg VA 24503
1
Lynchburg

- * -

Ken Alphin
Rillhurst Farm Nursery
PO Box 1276
Culpeper VA 22701
15
Culpeper

- * -

Richard T. Antony
Long Mountain Nursery
Route 1, Box 893
Washington VA 22747
1
Rappahannock

- * -

Pine Top Farm & Nursery
Box 35 C
Topping VA 23169
3
Middlesex

- * -

W. G. L. Farms, Inc.
Route 3, Box 197
Floyd VA 24091
40
Floyd

- * -

Harris & Moss
H & M Nursery
Route 1, Box 1044
Danville VA 24541
4
Danville

- * -

Audrey S. Dahle & R.M. Sprinkle
Green Acre Nursery
3901 Holland Road
Suffolk VA 23434
1
Suffolk

- * -

A.S. Allen
Caledonia Gardens
Route 3 Box 46
Amelia VA 23002
1
Amelia

- * -

George Ames
G & G Nursery
Box 815
Eastville VA 23347
1
Northampton

- * -

W.J. Arguin
McLean Nurseries
1821 Kirby Road
McLean VA 22101
1
Fairfax

- * -

Walter D. Arnold
Haynesfield Nurseries
PO Box 846
Bristol TN 37621
50
Smyth

- * -

M. A. Bacher
760 Applewood Lane
Great Falls VA 22066
1
Fairfax

- * -

Walter E. Barbee
Evergreen Farm
10644 Gunston Road
Lorton VA 22079
2
Fairfax

- * -

Stuart Barrell
Route 2, Box 185
Etlan VA 22719
1
Madison

- * -

Robert Bauserman
Bauserman Conifer Farm
North Main St., PO Box 55
Edinburg VA 22824
30
Shenandoah

- * -

Dannie Beebe
Beebe Landscape Design
Route 4, Box 238-C
Charlottesville VA 22901
1
Charlottesville

- * -

Gordon Bennett
Bennett's Nursery, Inc.
PO Box 216
Vienna VA 22180
4
FAirfax

- * -

Ms. James E. Askew
Askew's Nursery
1665 Old Buckroe Road
Hampton VA 23664
2
Hampton

- * -

Thomas Bagwell
D & M Nursery
RFD 1, Box 285
Onancock VA 23417
1
Accomack

- * -

C. Keeton Barnes
Route 1, Box 530
Washington VA 22747
4
Rappahannock

- * -

David M. Bartley
Long Meadow Nursery
Route 2, Box 340
Waynesboro VA 22980
1
Waynesboro

- * -

Richard C. Beaton
Laurelton Greenhouses
Route 4, Box 424
Gretna VA 24557
1
Pittsylvania

- * -

Frederick L. Belden
Ewell Farm Nurseries
PO Box 87
Norge VA 23127
5
James City

- * -

J. Edward Bennett
Bennett Evergreen Gardens
1712Collingwood Road
Alexandria VA 22308
1
Alexandria

- * -

R.W. Askew
R.W. Askew Nurseries
108 Longwood Ave
Suffolk VA 23434
75
Suffolk

- * -

Donald Bakker
Bakker's Acres
Route 3, Box 787
King George VA 22485
2
King George

- * -

Ernest L. Barnett
Barnett & Son Tree Company
128 Club Drive
Quinton VA 23141
1
New Kent

- * -

Charles Batcheler
Northern Virginia Nursery, Inc.
Route 2, Box 310
Nokesville VA 22123
22
Prince William

- * -

Dr. Peter Beckjord
Sweet Chaos Farm
Route 1 Box 172
Bluemont VA 22012
1
Loudoun

- * -

Walter C. Bell, JR.
Bell's Farm Nursery
4038 Harborwood Road
Salem VA 24153
3
Salem

- * -

Pearson B. Bennett
1903 Beullah Road
Vienna VA 22180
1
Fairfax

- * -

Harold M. Brown
Buffalo Creek Nursery
Route 1
Forest VA 24551
2
Bedford

- * -

Lloyd N. Browning
Lloyd's Plant Farm
1524 Hickory Hill Road
Petersburg VA 23802
1
Prince George

- * -

Thomas Burford
Burford Brothers Nursery
Route 1
Monroe VA 24574
2
Amherst

- * -

Lee S. Burnop
Lee S. Burnop Nursery
Route 1
Marion VA 24354
8
Smyth

- * -

Mrs. Scot Butler
Bluemont Boxwoods
PO Box 190
Bluemont VA 22012
1
Loudoun

- * -

Marvin Carden, II
Blue Ribbon Christmas Farms
P.O. Box 208
Christiansburg VA 24073
20
Floyd

- * -

J.E. Cartwright
Cartwright's Nursery
Box 745, Route 1
Saluda VA 23149
3
Glaucester

- * -

Irene Brown
6942 Connie Drive
Roanoke VA 24019
50
Floyd

- * -

J.G. Bruce
Hanover Farms Nursery
Route 1, Box 1120
Rockville VA 23146
5
Hanover

- * -

E.D. Burgin
Woodland Hill Tree Farm
Route 1, Box 214
Woolwine VA 14185
50
Patrick

- * -

W. & B. Butcher
Shenandoah Nursery
PO Box 213
Broadway VA 22815
1
Rockingham

- * -

Pauline M. Buxton
Buxton's Sugar Hollow Nursery
Route 2, Box 330
Crozet VA 22932
1
Charlottsville

- * -

George Carter
Ivy Nursery, Inc.
570 Broomley Road
Charlottesville VA 22901
7
Charlottesville

- * -

Billy Jean Carty
The Greenway Nursery
Box 56
Rocky Gap VA 24366
1
Bland

- * -

Ormonde Brown
Little Elf Nursery
102 Pine Cone Drive
Huddleston VA 24104
3
Bedford

- * -

Jim Burch
Landscape Development Company
16307 Carrs Mill Road
Woodbine MD 21797
5
Accomack

- * -

G. Burkhardt
Burkhardt's Nursery, Inc.
Route 1, Box 365
Hurt VA 24563
40
Pittsylvania

- * -

J.T. Butler
J.T. Butler Nursery
920 Oklahoma Drive
Chesapeake VA 23323
1
Chesapeake

- * -

E.A. Byrne
Prosper Pine Farms
8924 Ox Road, Route 123
Lorton VA 22079
1
Fairfax

- * -

C.P. Cartwright
2701 Mark Street
Chesapeake VA 23324
2
Chesapeake

- * -

E. & W. Carwile
Carwiles Nursery
11423 Scotland Lane
Glen Allen VA 23060
2
Henrico

- * -

Cecil Case
Cases Nursery
8521 Woodlawn Court
Alexandria VA 22309
5
Alexandria

- * -

Robin B. Chase
Highlander Nursery
Route 1, Box 206
Pilot VA 24138
12
Montgomery

- * -

Reginald Clark
Copper Hill VA 24079
150
Floyd

- * -

Stephen Cockerham
Betty's Azalea Ranch
12507 Lee Highway
Fairfax VA 22030
2
Fairfax

- * -

William & J. Cole
Cole Nurseries
5012 Lee Highway, RT. 15
Bristol VA 24201
30
Washington

- * -

Howard Conklin
Conklin's Nursery
Route 1, Box 1119
Weems VA 22576
1
Lancaster

- * -

Edward F. Connor
Blandy Experimental Farm
Boyce VA 22620
1
Clarke

- * -

Cecil C. Case
Hybla Valley Nursery
2801 Beacon Hill Road
Alexandria VA 22306
3
Alexandria

- * -

C.D. Chittum
Chittum's Greenhouses
Route 1, Box 50
Hayes VA 23072
1
Gloucester

- * -

Woodrow W. Clark
Copper Hill Nursery
Route 1 Box 12
Copper Hill VA 24075
1
Floyd

- * -

Mrs. E.E. Colbert
4733 Old Dominion Drive
Arlington VA 22207
1
Arlington

- * -

Edmund M. Coleman
Rapidan Berry Gardens
PO Box 55
Rapidan VA 22723
6
Culpeper

- * -

Howard Conklin
Conklin's Nursery
Route 1, Box 1119
Weems VA 22576
1
Lancaster

- * -

Bertram Cooper
Chota Koti Garden
8524 Overbrook Road
Fairfax VA 22030
1
Fairfax City

- * -

K. & B. Charnock
The Charnock's Nurseries
Box 437
Belle Haven VA 23306
1
Accomack

- * -

Lewis D. Clark
2026 Mayfield Dr SE
Roanoke VA 24014
1
Roanoke County

- * -

J.S. Coartney
White Oak Grove Nursery
Routl
Riner VA 24149
200
Montgomery

- * -

Thomas L. Cole
C/O Audrey E. Cole
2903 Chain Bridge Road
Oakton VA 22124
1
Fairfax

- * -

John G. Collins
Hedgerow Hill Nursery
5060 Lee Highway
Bristol VA 24201
3
Washington

- * -

R.L. Connelly
Connelly's Nursery
4912 Hickory Road
Petersburg VA 23803
1
Chesterfield

- * -

Ronald Cooper
York Ridge Tree Farm & Nursery
Route 2, Box 284
Mouth of Wilson VA 24363
10
Grayson

- * -

Union Camp Corporation
Union Camp Nursery
Routel, Box 129
Capron VA 23829
22
Southhampton

- * -

David Cox
Cox's Nursery
3500 Prices Fork Road
Blacksburg VA 24060
3
Montgomery

- * -

M.D. Crosby
3517 Prosperity Avenue
Fairfax VA 22030
1
Fairfac City

- * -

Elizabeth Cummings
Wild Gardens
PO Box 277
Aldie VA 22001
5
LOudoun

- * -

Jim Curtis
Lost Corner Nursery, Inc.
Route 4, Box 196
Leesburg VA 22075
10
Loudoun

- * -

A. & V. Daughtry
Blue Ridge Nursery
1505 Blue Ridge Rd.
Chesapeake VA 23322
2
Chesapeake

- * -

T.W. Davis/M.L. Hardy
Davis & Hardy Nursery
Route 6, Box 1922
Danville VA 24541
10
Danville

- * -

Harry E. Corr
Roadview Farm Nursery, Inc.
PO Box 966
Gloucester VA 23061
15
Gloucester

- * -

John C. Cox
Route 3, Box 383
Hillsville VA 24343
10
Carroll

- * -

Richard Crouch
Crouch's Nursery
Route 5, Box 498
Bassett VA 24055
1
Henry

- * -

Blair W. Cupp
Wolftrap Nursery, Inc.
9439 Leesburg Pike
Vienna VA 22180
1
Fairfax

- * -

Bob Daley
C.F. Daley & Son
PO Box 162
Tasley VA 23441
5
Accomack

- * -

Claude & James Davis
Davis Bros. Nursery, Inc.
Route 2, Box 340
Rose Hill VA 24281
70
Lee

- * -

Tom De Baggio
Earthworks
923 North Ivy Street
Arlington VA 22201
1
Arlington

- * -

Everett S. Cortright
Route 1, Box 301C
Marshall VA 22115
1
Fauquier

- * -

Victor L. Crim
Crim's Nursery
Route 1, Box 146-G
Clearbrook VA 22624
4
Frederick

- * -

Thomas M. Crowell
Crowell Nursery
1622 10 St. NW
Roanoke VA 24012
5
Roanoke

- * -

Kevin Currie
Evelynton Associates
Route 2, Box 145
Charles City VA 23030
10
Charles City

- * -

William M. Daley
Broadleaf Gardens
RD#2, Box 7-B
Onancock VA 23417
10
Accomack

- * -

Ray C. Davis
Davis Lawn Services, Inc.
PO Box 1
Mechanicsville VA 23111
1
Hanover

- * -

John B. Deaton
Manakin VA 23103
75
Goochland

- * -

Charles S. Dehaven
Dehaven Nursery, Inc.
Route 8, Box 690
Winchester VA 22601
5
Frederick

- * -

H.J. Devos
Mountain View Nursery
Route 1, Box 39
Greenville VA 24440
8
Augusta

- * -

George E. Dodrill
6003 Balsam Drive
McLean VA 22101
1
Fairfax

- * -

Fred Duis
The Duis Nursery
Route 1, Box 387-A
Bedford VA 24523
20
Bedford

- * -

James E. Mays
Virginia Beach Vineyards
5320 Gale Drive
Virginia Beach VA 23462
1
Virginia Beach

- * -

Lloyd C. Edwards
Pee Wee Nursery
3221 Grove Avenue
Chester VA 23831
1
Chesterfield

- * -

Elliot & Elliot
Cedarville Nursery
3217 Cedarville Road
Chesapeake VA 23320
1
Chesapeake

- * -

W.E. Dennis
Dennis Nursery
Box 88
Wattsville VA 23483
10
Accomack

- * -

C.M. & B.S. Dixon
Shenandoah Valley & F.N.
Route 1, Box 142
McGaheysville VA 22840
1
Rockingham

- * -

James R. Doughty
Forest Grove Nursery
RFD Box 487
Painter VA 23420
2
Accomack

- * -

W.E. Dunton
W.E. Dunton Nursery
RFD 1, Box 163
Exmore VA 23350
1
Northampton

- * -

Byard Early
Early Nursery
Route 3, Box 111
Dayton VA 22821
2
Rockingham

- * -

Norman V. Edwards
Rolling Oaks Farm
5500 Twin Hickory Lane
Glen Allen VA 23060
5
Henrico

- * -

R. Emory
Holiday Tree Farm
4701 Cheverly Court
Virginia Beach VA 23464
4
Virginia Beach

- * -

Margaret Dereski
Arlington Road
Hopewell VA 23860
1
Hopewell

- * -

H. Walter Dobyns
Allison's Greenhouse
Route 4, Box 66
Dublin VA 24084
1
Pulaske

- * -

C.M. Driver
Driver Brothers, Inc.
Route 6, Box 486-C
Staunton VA 24401
2
Staunton

- * -

Gary N. Duren
Danville Landscape Nursery
PO Box 206
Danville VA 24541
15
Danville

- * -

Byard Early
Early Nursery
Route 3, Box 111
Dayton VA 22821
2
Rockingham

- * -

Henry Eiden
Blumenbau Nursery
Route 1, Box 186
Earlysville VA 22936
2
Albemarle

- * -

Wm. H. Englander
Beech Hill Farm
Route 1, Box 281
Remington VA 22734
20
Fauquier

- * -

Sally A. Evans
Evans Evergreen Nursery
Route 1, Box 60C
Providence Forge VA 23140
2
New Kent

- * -

J. Ferrara
Campbell & Ferrara Nursery
6651 Little River Turnpike
Alexandria VA 22312
60
Fairfax

- * -

C.F. Flemer III,
Ingleside Plantation Nursery
PO Box 1038
Oak Grove VA 22443
800
Westmoreland

- * -

Randy & Terry Fogle
Fort Valley Nursery
HC-60 Box 3766
Fort Valley VA 22652
16
Shenandoah

- * -

Arthur W. Frazer
Columbia Nursery
1903 Marthas Road
Alexandria VA 22307
1
Fairfax

- * -

R.B. Fuller
Fuller Nursery
501 North Ivy Avenue
Highland Spring VA 23075
1
Henrico

- * -

Robie Gallimore
Horse Ridge Nursery
Route 1, Box 30
Indian Valley VA 24105
25
Floyd

- * -

J.B. Farrar
Route 1, Box 76
Blackstone VA 23824
1
Nottoway

- * -

Nancy V. Firestone
Homewood Nursery
PO Box 428
Troutville VA 24175
6
Botetourt

- * -

Herman Fletcher
Little Five Azalea Farm
4303 Fauquier Ave
Richmond VA 23227
8
Henrico

- * -

Randy & Terry Fogle
Fort Valley Nursery
Fort Valley Route, Box 311
Saint Davids Ch. VA 22652
16
Shenandoah

- * -

Linda Frederick
Blue Ridge Wood Nursery
Route 1, Box 246
Pilot VA 24138
38
Floyd

- * -

Samuel M. Gaddy
Colesville Nursery, Inc.
PO Box 208
Ashland VA 23005
10
Hanover

- * -

Manning Gasch
Orchard Spring Nursery
8501 Georgetown Pike
McLean VA 22102
2
Fairfax

- * -

Lee Fentress
London Bridge Greenhouses
105 N. Great Neck Road
Virginia Beach VA 23454
1
Virginia Beach

- * -

John Fitzpatrick
Thomas Jefferson Mem. Foundation
PO Box 316
Charlottesville VA 22902
1
Charlottesville

- * -

Paul O. Flynn
Flynn Azalea Garden, Inc.
3000 Skipwith Road
Richmond VA 23229
4
Henrico

- * -

Jack Foster
J.P. Foster Nursery, Inc.
442 S. Battlefield Blvd.
Chesapeake VA 23320
1
Chesapeake

- * -

James R. Frith
Skyline Evergreen Farm
4919 North 14TH Street
Arlington VA 22205
40
Arlington

- * -

Monroe Gallimore
Gallimore's Nursery
Indian Valley VA 24105
2
Floyd

- * -

William H. Gaskins, Jr.
Gaskins Nursery
Route 3, Box 173
Emporia VA 23847
1
Emporia

- * -

William F. Geier
Atlantic Landscape Nursery
Route 1, Box 1303
White Stone VA 22578
1
Lancaster

- * -

Mr. & Mrs. George Cadiero
Kelso Station Nursery
Route 2, Box 108
Bedford VA 24523
1
Bedford

- * -

R.V. Gillispie, Jr.
Junction Nursery
Route 1
Cascade VA 24069
5
Pittsylvania

- * -

Ralph L. Godwin
Ralph L. Godwin Nursery
Box 1
Bloxom VA 23308
2
Accomack

- * -

D. Grandstaff
Hayfield Nursery
Route 2, Box 408
Winchester VA 22601
8
Frederick

- * -

David Greene
Greene House Nursery
RFD Box 119
Parksley VA 23421
2
Accomack

- * -

Don Hager
Hager Nurseries, Inc.
RFD 5, Box 2000
Spotsylvania VA 22553
5
Spotsylvania

- * -

General Booth, Inc.
Great Big Greenhouse & Nursery
1291 Ferrell Parkway
Virginia Beach VA 23454
10
Virginia Beach

- * -

James E. Gillespie
Gillespie Gardens
401 Pelham Drive
Waynesboro VA 22980
1
Augusta

- * -

Leonard C. Goad
Goad's Nursery
PO Box 8
Indian Valley VA 24105
50
Floyd

- * -

Clyde Goode
Swift Creek Berry Farm
17210 Genito Road
Moseley VA 23120
1
Chesterfield

- * -

Wilburn B. Graves
Graves Plant Farm
Route 1, Box 498-B
Mechanicsville VA 23111
5
Hanover

- * -

Richard Griffith
Aslan Nursery
Route 1, Box 111-B
Pamplin City VA 23958
1
Appomattox

- * -

David W. Hale
Beaver Creek Nursery
Route 2, Box 407
Floyd VA 24091
50
Floyd

- * -

Paul Genovese
Plant Factory & Nursery
PO Box 64157
Virginia Beach VA 23464
3
Virginia Beach

- * -

Frances C. Gillispie
PO Box 474
Chase City VA 23924
1
Mecklenburg

- * -

Robert Godsey
Flatridge Farms, Inc.
Route 1, Box 66
Troutdale VA 24378
62
Grayson

- * -

Richard Goode
Chesterfield Berry Farm
20501 Skinquarter Road
Moseley VA 23120
1
Chesterfield

- * -

W.A. Gray
Brecknock Nursery
485 Gillums Ridge Road
Charlottesville VA 22901
2
Albemarle

- * -

W.T. Grunwell
3701 Prosperity Avenue
Fairfax VA 22031
1
Fairfax City

- * -

Granville L. Hall
Route 6, Box 7365
Gloucester VA 23061
4
Gloucester

- * -

E.T. Hickman, JR.
Hickman Nursery
Box 2A
Oak Hall VA 23416
1
Accomack

- * -

Richard M. Hicks
PO Box 580
North VA 23128
7
Mathews

- * -

J. & H. Hill
Hills Nursery & Camelia Garden
1722 N. Glebe Rd.
Arlington VA 22207
17
Fairfax

- * -

Richard M. Hobgood
PO Box 437
Buffalo Junction VA 24529
1
Mecklenburg

- * -

K. Hollandsworth
Hollandsworth Nursery
Route 2
Willis VA 24380
125
Floyd

- * -

Lanzie Horton, Sr.
Horton's Nursery & Tree Farms
Route 1, Box 29
Hillsville VA 24343
10
Carroll

- * -

D.M. Hubbard
Hubbard's Landscape Service
Route 3, Box 315
Troutville VA 24175
2
Botetourt

- * -

James T. Hicks
Hicks Tree Farm
Route 1, Box 290
Saltville VA 24370
10
Smyth

- * -

Mrs. F.M. Hickson
F.M.Hickson & Son
Route 3
Nathalie VA 24577
HALIFAX
30

- * -

Mike Hinson
Meadow Creek Tree Farm
RT. 1, Box 188
New Castle VA 24127
18
Craig

- * -

R.A. Hoenig
Indian Creek Nursery
3300 Indian Creek Road
Virginia Beach VA 23457
1
Virginia Beach

- * -

Tom Holman
Boulderbrook Gardens
Route 1, Box 758
Dinwiddie VA 23841
1
Dinwiddie

- * -

Russell Howell
Howell's Evergreen Nursery
HC67, Box 43A
Floyd VA 24091
100
Floyd

- * -

W. M. Hudgins
Box 28
Hayes VA 23072
3
Gloucester

- * -

Mrs. Jack H. Hicks
Route 2, Box 505
Evington VA 24550
1
Campbell

- * -

Donald G. Hile
Gla-Don Plants
Route 3, Box 1159
Gloucester VA 23061
2
Gloucester

- * -

Wiley A. Hinson
Salem Nursery
2275 Salem Road
Virginia Beach VA 23456
1
Virginia Beach

- * -

Eugene Hogge
Greenbrier Farms, Inc.
201 Hickory Road West
Chesapeake VA 23322
675
Chesapeake

- * -

Jean Holt
Ashland Greenhouses
PO Box 874
Ashland VA 23005
3
Hanover

- * -

Donavan Hower
Gobbler's Nob
Route 3, Box 14A
McDowell VA 24458
40
Highland

- * -

William T. Hudgins
Clay's Garden Center
Route 1, Box 11-F
Blackstone VA 23824
3
Nottoway

- * -

Frank L. Huerta
Frank L. Huerta Nursery
3001 Bray Road
Virginia Beach VA 23452
1
Virginia Beach

- * -

Wayne Hughes
Lilac Farms
Route 1, Box 1117
Rhoadesville VA 22542
6
Orange

- * -

D.W. Hyatt
Stonehouse Creek Nursery
1948 Lorraine Avenue
McLean VA 22101
2
Fairfax

- * -

Ron Jenkins
New Kent Forestry Ct.
Route 2, Box 42-A
Providence Forge VA 23140
125
New Kent

- * -

Mrs. J.M. Johnson
1817 West 45th Street
Richmond VA 23225
1
Chesterfield

- * -

D.J. Jones
Olive Hill Farm Nurseries
7301 River Road
Matoaca VA 23803
2
Chesterfield

- * -

H. Dean Jones
Jones Nursery Company
PO Box 13571
Roanoke VA 24035
1
Roanoke

- * -

Clarence Huff
Route 1, Box 53
Indian Valley VA 24105
28
Floyd

- * -

Bob Hurst
Timbercreek Farm
Route 5, Box 339
Charlottesville VA 22901
40
Albemarle

- * -

Mike Jackson
Panorama Farms Nursery
Route 1, Box 11
Ashburn VA 22011
10
Loudoun

- * -

C.V. Johnson
Johnson's Nursery
Box 85
Crewe VA 23930
2
Nottoway

- * -

Raymond Johnson
Johnson's Flowers, Inc.
3201 Holland Road
Suffolk VA 23434
2
Suffolk

- * -

David W. Jones
Blackwater Nursery
PO Box 465
Boones Mill VA 24065
2
Franklin

- * -

Henry B. Jones
Stringwood Landscape Nursery
Route 1, Box 242
Carrsvile VA 23315
1
Isle of Wight

- * -

H.B. Huggins
Historyland Nursery, Inc.
Route 1, Box 485
Montross VA 22520
15
Westmoreland

- * -

Gary M. Hutt
Red Oak Nurseries
Rt 2 Box 374
Montross VA 22520
3
Westmoreland

- * -

C.D. Jefferson
Glen Mary Nursery, Inc.
PO Box 208
Nellysford VA 22958
130
Nelson

- * -

Inez S. Johnson
Coves Head Nursery
Box 127
Kinsale VA 22488
1
Westmoreland

- * -

Bill K. Jones
Riverview Farm
PO Box 82
Hiltons VA 24258
15
Scott

- * -

E. W. Jones
Jones Nursery
PO Box 103
Woodlawn VA 24381
10
Carroll

- * -

Lester Jones
Jones Greenhouse
Route 2, Box 437
Cana VA 24317
1
Carroll

- * -

Nancy Letteri
Springwood Gardens
4300 Springwood Drive
Free Union VA 22940
1
Albemarle

- * -

Jim Lewis
J. Lewis & Sons
Route 1, Box 44
Cascade VA 24069
1
Pittsylvania

- * -

Raymond Lewis
Accawmacke Ornamentals
P.O. Box 4
Tasley VA 23441
4
Accomack

- * -

E.T. Lilliston
E.T. Lilliston Nursery
Box 125
Onancock VA 23417
1
Accomack

- * -

John L. Machen
Mobjack Nurseries
Route 660
Mobjack VA 23118
50
Mathews

- * -

Randy Marks
Garden Design Company
Route 1, Box 144
Culpeper VA 22701
11
Culpeper

- * -

Mr. Marsland
Frank Marsland Nursery
25 Balmoral Dr.
Hampton VA 23669
1
Hampton

- * -

A.H. Lewis
Sea Bay Nursery
PO Box 8
Bloxom VA 23308
4
Accomack

- * -

Leo Lewis
Holly Hill Nursery
2509 Horner Road
Woodbridge VA 22191
2
Prince William

- * -

E.G. Lewis, Inc.
Yeatts Nursery
Route 1, Box 66
Martinsville VA 24112
17
Henry

- * -

John Link
Belvins Nursery
3005 Bray Road
Virginia Beach VA 23452
2
Virginia Beach

- * -

R. D. Mahone
Williamsburg Nursery
Box 751
Williamsburg VA 23187
3
James City

- * -

CJ & DC Marshall
Native Evergreen Nursery
Willis VA 24380
200
Floyd

- * -

Mrs. Walter L. Massie
225 Woodson Lane
Lynchburg VA 24503
1
Campbell

- * -

Herbert Lewis
Lewis Nurseries
Cascade VA 24069
100
Pittsylvania

- * -

Leo Lewis
Holly Hill Nursery
2509 Horner Road
Woodbridge VA 22191
2
Prince William

- * -

J.H. Lewis, Jr.
Lewis Landscape Service
Cascade VA 24069
3
Pittsylvania

- * -

Mrs. Harold Little
Box 757
Tappahannock VA 22560
1
Essex

- * -

M.W. & Diane Mann
Maple Hollow Greenhouse
Route 4, Box 132
Gretna VA 24557
1
Pittsylvania

- * -

Ernie Marshall
Marshall Nurseries
PO Box 92
Riner VA 24149
600
Radford

- * -

Plato P. Mathews
Mathews Greenhouse, Inc.
2737 Bunch Walnuts Road
Chesapeake VA 23322
3
Cheapeake

- * -

Rich Mathis
Brook Hill Landscapes
PO Box 15239
Richmond VA 23227
5
Richmond City

- * -

Ed Maurer
Westmoreland Davis Memorial
Route 3, Box 50
Leesburg VA 22075
1
Loudoun

- * -

L. McAllister
McAllister Landscape Service
Route 3, Box 49
Wytheville VA 24382
1
Wythe

- * -

Michael McConkey
Edible Landscaping
PO Box 77
Afton VA 22920
1
Nelson

- * -

Stanley Mercer
Mercer's Nursery
Route 1, Box 717
Atkins VA 24311
25
Pittsylvania

- * -

G.B. Midkiff
"Bob Pond" Blueberry Farm
P.O. Box 331
Rich Creek VA 24147
5
Giles

- * -

Gilbert Miles
The Greenhouse
PO Box 66
Glen Allen VA 23060
2
Henrico

- * -

Archie Matthews
C & M Nursery
1668 Mt. Pleasant Road
Chesapeake VA 23322
2
Chesapeake

- * -

Mrs. L.H. Maynard
Spring Hill Farm
Route 2, Box 1275
Hanover VA 23069
4
Hanover

- * -

Patricia McBee
Five Corners Nursery
1117 Brookwood Lane
Waynesboro VA 22980
1
Waynesboro

- * -

Jeff McCormack
Southern Exposure Seed
PO Box 158
North Garden VA 22959
1
Albemarle

- * -

William B. Meredith, Jr.
Route 2, Box 314
Mineral VA 23117
2
Louisa

- * -

Jean Mihalyka
Cherrycore
Cheriton VA 23316
1
Northampton

- * -

David L. Miller
Millers' Nurseries
Route 2, Box 127 B
Moneta VA 24121
1
Bedford

- * -

Thomas J. Matthews
Matthews Nursery
PO Box 47
Wattsville VA 23483
3
Accomack

- * -

William N. Mays
Sunnyside Boxwood Farm
PO Box 68
Amherst VA 24521
35
Amherst

- * -

Wayne McBee
Augusta Forestry Ct.
PO Box 9028
Crimora VA 24431
88
Augusta

- * -

K. McDonald, Jr.
Lemac Nurseries, Inc.
PO Box 268
Hampton VA 23669
25
Hampton

- * -

Steven P. Middleton
Turpin Nursery
PO Box 38
Floyd VA 24091
30
Floyd

- * -

Dave W. Milam
Three Springs Farm
7249 Wilson Road
Boones Mill VA 24065
10
Franklin

- * -

Jeff Miller
Laurel Creek Nursery
PO Box 10291, Route 114
Blacksburg VA 24062-0291
460
Montgomery

- * -

S.L. Miller
Canna International of Melfa
Box 487
Melfa VA 23410
10
Accomack

- * -

James H. Montgomery
Montgomery's Nursery
Route 1
Boones Mill VA 24065
2
Franklin

- * -

J.M. Moseley,
The Marshall Place
Route 2, Box 93
Dillwyn VA 23936
1
Buckingham

- * -

Corry Mulligan
Pinesong Azaleas
107 Quaker Meeting House Rd.
Williamsburg VA 23185
1
James City

- * -

William K. Neal
The Tankard Nurseries
PO Box 649
Exmore VA 23350
500
Northampton

- * -

Lynnwood Norris
Norland Nursery
PO Box 535
Wakefield VA 23888
1
Sussex

- * -

Robert T. O'Keeffe
Rifton Farm & Nursery
Route 1, Box 245
Pilot VA 24138
20
Floyd

- * -

Bill Minor
Smalts Garden Center
422 National Ave.
Winchester VA 22601
2
Frederick

- * -

A.J. Moody
Wayside Nursery & Craft Shop
Route 1, Box 9
South Hill VA 23970
1
Mecklenburg

- * -

Dorothy Mueller
1350 N. Washington Street
Highland Spring VA 23075
1
Henrico

- * -

John & Susan Mullin
Ridgeway Farm
Route 2, Box 80
Brookneal VA 24528
25
Charlotte

- * -

Thomas F. Neil
White Oak Nurseries, Inc.
12521 Lee Highway
Manassas VA 22110
1
Prince William

- * -

William G. O'Brien
117 Magnolia
Franklin VA 23851
1
Southampton

- * -

VA Department Of Forestry
Garland Gray Forestry Center
Route 2, Box 111
Courtland VA 23837
80
Southland

- * -

Kerry Moles
Willow Tree Nursery, Inc.
Route 1, Box 108
Penhook VA 24137
5
Franklin

- * -

C.T. Mooney
Crowder & Mooney Nursery
Route 1 Box 43
Baskerville VA 23915
1
Mecklenburg

- * -

Margaret Lee Mulick
Williston Nursery
Orange VA 22960
5
Orange

- * -

Emmett M. Myers
Myers Nursery
1460 Bridge Point Trail
Suffolk VA 23432
1
Suffolk

- * -

D.R. Nichols
Route 1, Box 89
Floyd VA 24091
30
Floyd

- * -

Mrs. Susan O'Hara
Littlefield Gardeners
2115 White Oaks Drive
Alexandria VA 22306
1
Alexandria

- * -

Randy Osborne
Old Towne Gardens
Route 1, Box 245
Independence VA 24348
10
Grayson

- * -

J.R. Prillaman
Prillaman Nursery
Box 987 Figsboro Road
Martinsville VA 24114
16
Henry

- * -

F.W. Quaiff
7232 Hopkins Road
Richmond VA 23237
1
Chesterfield

- * -

Harold E. Rapczyk
Hal & Bea Nursery
RT 1, Box 98
White Post VA 22663
3
Clarke

- * -

Claude Reeson
C.W. Reeson Nursery
Spring Grove VA 23881
1
Surry

- * -

Jack Richardson
Dancing Creek Nursery
2067 Logan Street
Bon Air VA 23235
1
Chesterfield

- * -

Janipher Robinson
PO Box 86
Ashland VA 23005
3
Hanover

- * -

David F. Sauer
14201 Ramblewood Drive
Chester VA 23831
2
Chesterfield

- * -

HL & MN Pruitt, Jr.
Pruitt Landscape Service
440 Keller Lane
Marion VA 24354
20
Smyth

- * -

Ray Quillen
Waynesboro Nurseries
PO Box 987
Waynesboro VA 22980
1000
Waynesboro

- * -

Roger E. Rardin
The Tyler Rose
PO Box 864
Salem VA 24153
1
Roanoke

- * -

S. Michael Reynolds
Crabtree
1036 Dandridge Drive
Lynchburg VA 24501
2
Lynchburg

- * -

Robin A. Rinaca
Eastern Shore Nursery of Virginia
Box 69
Keller VA 23401
50
Accomack

- * -

Fred Rotenberry
Rotenberry Plant Farm
Route 1, Box 72
Hillsville VA 24343
1
Carroll

- * -

Paul M. Saunders
Piney River VA 22964
15
Nelson

- * -

Philip Purrington
Commonwealth Nursery
PO Box 220
Merry Point VA 22513
2
Lancaster

- * -

S.E. Quillen
Waynesboro Landscape Service
2032 W. Main Street, Box 717
Waynesboro VA 22980
15
Waynesboro

- * -

Gabriele Rausse
Simeon Vineyard, Ltd.
RFD 9, Box 293
Charlottesville VA 22901
2
Charlottesville

- * -

Glenn Richardson
The Plant Man Ltd.
3411 Kingsland Road
Richmond VA 23237
10
Chesterfield

- * -

Robert E. Lee
Memorial Association, Inc.
Stratford Hall
Stratford VA 22558
1
Westmoreland

- * -

Benjamin J. Russo
Benarr Nursery
PO Box 405
Winchester VA 22601
1
Frederick

- * -

E. Martin Schara
The Great Big Greenhouse
5405 East Indian River Road
Virginia Beach VA 23464
3
Virginia Beach

- * -

James E. Sellers
Sellers Company Nursery
1163 Hillwell Road
Chesapeake VA 23320
1
Chesapeake

- * -

C.H. Shaffer
11037 Timberlake Road
Lynchburg VA 24502
1
Lynchburg

- * -

Edward A. Shelton, Sr.
27 Robinson Drive
Newport News VA 23601
1
Newport News

- * -

A.J. Shoosmith
Southside Nurseries, Inc.
9040 Dorsey Rd.
Richmond VA 23237
48
Chesterfield

- * -

Steve Shreckhise
Shrickhise Shrubbery
Route 1, Box 230
Weyers Cave VA 24486
2
Augusta

- * -

S.F. Simpson, Sr.
Edgewood Farm Nursery
318 Poplar Road
Falmouth VA 22405
2
Stafford

- * -

Wright Smith
Blue Ridge Tree Farms
PO Box 1746
Wilson NC 27894
50

- * -

Brooks Semple
Suffield Farm Nursery
Route 6, Box 271
Warrenton VA 22186
24
Fauquier

- * -

R. W. Sharp
Route 2, Box 566
The Plains VA 22171
2
Fauquier

- * -

B.B. Sheppard
4117 Park Avenue
Richmond VA 23221
1
Henrico

- * -

Armen Showalter
Indian Valley Nursery
Box 170
Indian Valley VA 24105
8
Floyd

- * -

Benji Shumaker
Buckingham Nurseries
PO Box 185
Dillwyn VA 23936
10
Buckingham

- * -

David A. Sirna
Walnut Ridge Farm
PO Box 187
Clearbrook VA 22624
15
Frederick

- * -

Archie M. Smith, Jr.
Meredyth Vineyards
PO Box 347
Middleburg VA 22117
1
Loudoun

- * -

F. Sexauer, Jr.
Belle Haven Azalea Farm Inc.
PO Box 367
Belle Haven VA 23306
5
Accomack

- * -

W.R. Shelton
Rural Plains Nursery
Rt. 7 Box 20
Mechanicsville VA 23111
5
Hanover

- * -

P. & T. Sheuchenko
Lazy S's Farm
Route 1, Box 334
Barboursville VA 22923
8
Orange

- * -

Denise Shreckhise
Shreck's Ornamentals
PO Box 43
Grottoes VA 24441
10
Rockingham

- * -

Shumaker & Southall
English Boxwoods of Virginia
3838 Faculty Drive
Lynchburg VA 24501
1
Lynchburg

- * -

Homer G. Smith
Colonial Garden Nursery
PO Box 474
Drakes Branch VA 23937
10
Charlotte

- * -

Duane E. Snow
Snow's Garden Center
Avon Street Extd.
Charlottesville VA 22901
2
Albemarle

- * -

Jim Snyder
Riverbend Nursery
Route 1, Box 204A
Riner VA 24149
18
Montgomery

- * -

Keith A. Stanley
The Gardner
12685 Broad Street Road
Richmond VA 23233
1
Goochland

- * -

N. Stettinius
White Oak Farm
Route 1, Box 256
Middleburg VA 22117
30
Loudoun

- * -

George Stockner
Stockner's Rockville Nursery
PO Box 82
Rockville VA 23146
17
Hanover

- * -

J. Nelson Stuart
Towles Point Holly
Route 1, Box 93
Reedville VA 22539
4
Northumberland

- * -

Robert Sturgis
Big Pine
Box 11
Belle Haven VA 23306
5
Accomack

- * -

Nancy Swell
Swell Azaleas
505 Baldwin Road
Richmond VA 23229
1
Henrico

- * -

Carl W. Spillers
6398 Vale Street
Alexandria VA 22312
1
Fairfax

- * -

Glen Sterling
Nursery Growers
Keller VA 23401
4
Accomack

- * -

Bruce E. Stevens
1035 White Oak Lane
Christiansburg VA 24073
1
Montgomery

- * -

Timothy Strickler
Bluebird Orchard & Nursery
Route 1, Box 352-A
Fries VA 24330
1
Grayson

- * -

Stuart-Averette
Tidewater Landscape Service
PO Box 1010
Chesapeake VA 23322
21
Chesapeake

- * -

Joe Sublett
Sublett's Nursery
Route 1, Box 261
Newport VA 24128
30
Craig

- * -

Joe E. Swinson, Jr.
Swinson's Nursery
Route 3, Box 24-A
Champlain VA 22438
2
Essex

- * -

Dorothy A. Sproles
Holly Creek Nursery
Box 232
Keller VA 23401
15
Accomack

- * -

James Stern
Machipongo Nurseries
Box 191
Machipongo VA 23405
1
Northampton

- * -

McHenry L. Stiff, III
Round Hill Garden
Route 7 Box 196
Round Hill VA 22141
1
Loudoun

- * -

J.H. Strite
Sunshine Plant Farm
Route 2, Box 272
Mineral VA 23117
1
Louisa

- * -

G. and A. Stuck
Stuck's Nursery
Route 2, Box 141F
Franklin VA 23851
6
Southampton

- * -

Fay S. Sullivan
1112 Little Neck Road
Virginia Beach VA 23452
1
Virginia Beach

- * -

David B. Tankard
David's Nursery
PO Box 926, Route 183
Exmore VA 23350
105
Northampton

- * -

Daniel Taylor
Taylor's Nursery
Route 6, Box 617
Bristol VA 24201
3
Bristol

- * -

W.H. Taylor, Jr.
Taylor's Nursery
RFD 1
Painter VA 23420
20
Accomack

- * -

Richard Titus
Doug's Christmas Tree Farm
1032 Centerville Turnpike
Chesapeake VA 23320
45
Chesapeake

- * -

H.L. Tucker, Jr.
Schloss Tucker-Ellis Vineyard
RD 1, Box 125-B
Waterford VA 22190
3
Loudoun

- * -

Elmer Vaughan
Elmer Vaughan Nursery
29 Robinson Drive
Newport News VA 23601
1
Newport News

- * -

Andre Viette
Andre-Viette Farm & Nursery
Route 1, Box 16
Fishersville VA 22939
40
Augusta

- * -

Robert Warren
Robert A. Warren Nursery
10708 Timberidge Road
Fairfax Station VA 22039
1
Fairfax

- * -

R.C. Taylor
Clay's Trees and Shrubs
71 Sunset Drive
Bristol VA 24201
2
Bristol

- * -

Robert L. Thomas
Fernvale Farms
Route 1, Box 163
Rustburg VA 24588
1
Campbell

- * -

James E. Truitt
Nandua Container Nursery
10 Hill Street
Onancock VA 23417
1
Accomack

- * -

D. & S. Vaughan
Vaughn's Nursery
Route 1, Box 636
Radford VA 24141
1
Radford

- * -

Elmer Vaughan
Elmer Vaughan Nursery
29 Robinson Drive
Newport News VA 23601
1
Newport News

- * -

Joseph Vinsh
Old Dominion Tree Farm
6512 West Quaker Road
Disputanta VA 23842
3
Prince George

- * -

Byron E. Wates, Jr.
Area Landscaping, Inc.
4118 Olley Lane
Fairfax VA 22032
3
Fairfax

- * -

W.H. Taylor
Taylor Azalea, Inc.
RFD
Painter VA 23420
4
Accomack

- * -

Wilbur G. Thorton
Thorton's Greenhouse
Route 1, Box 188
Hiwassee VA 24347
2
Pulaski

- * -

D. & V. Tubbs
Wilderness Road Farm
407 East Ben Oaks Drive
Severna Park MD 21146
50
Wythe

- * -

Elmer Vaughan
Elmer Vaughan Nursery
29 Robinson Drive
Newport News VA 23601
1
Newport News

- * -

Vavin, Inc.
Prince Michel Vineyards
Star Route 4, Box 77
Leon VA 22725
3
Madison

- * -

John F. Wampler
Algoma Nursery Company
Route 4, Box 590
Rocky Mount VA 24151
10
Franklin

- * -

C. Watkins
Watkins Nurseries, Inc.
15001 Midlothian Pike
Midlothian VA 23113
600
Chesterfield

- * -

William W. Watkins
Green Hill Nursery
401 Old Hundred Road
Midlothian VA 23113
1
Chesterfield

- * -

Dorothy Webb
Whayes End Nursery
PO Box 310
Burgess VA 22432
1
Northumberland

- * -

Richard P. Wesley
12676 River Road
Richmond VA 23233
1
Goochland

- * -

W.T. West, Jr.
West Nursery, Inc.
Route 10, Box 135
Mechanicsville VA 23111
3
Hanover

- * -

James B. White
Whiteoak Gardens
Route 4, Box 206-C
Lynchburg VA 24503
2
Lynchburg

- * -

Steve Wilkerson
Rainfrost Nursery
Route 1, Box 313
Forest VA 24551
1
Bedford

- * -

John D. Williamson
Williamson Landscaping, Inc.
PO Box 8763
Richmond VA 23226
1
Chesterfield

- * -

Evelyn F. Watts
Breezemont Plants
PO Box 57
Brightwood VA 22715
1
Madison

- * -

Mike Weber
Weber's Nursery
99 Lee Avenue
Winchester VA 22601
1
Frederick

- * -

John Wessel
Wessel Nursery
505 Gawain Court
Virginia Beach VA 23464
1
Newport News

- * -

S & D Wheelbarger
Shades of Green Nursery
Route 1, Box 317 A
Bridgewater VA 22812
15
Rockingham

- * -

Hugh C. Whitehead
Whitehead's Azalea Garden
1149 Olive Road
Virginia Beach VA 23464
1
Virginia Beach

- * -

E. Williams, Jr.
Dover Nurseries, Inc.
111 Deer Keep
Richmond VA 23233
6
Goochland

- * -

Homer S. Willie, Sr.
R.R. 11 Box 151
Petersburg VA 23803
3
Petersburg

- * -

Kenneth Weakland
Green Planters Garden Center
Box 687
Hayes VA 23072
1
Gloucester

- * -

Harry Wells
Nonesuch Nursery, Inc.
Route 1, Box 176
Pamplin VA 23958
80
Prince Edward

- * -

Mrs. D. C. West
Woodley Hills Nursery
4005 Laurel Road
Alexandria VA 22309
1
Alexandria

- * -

Bob Wherry
Bob Wherry's Nursery , Inc.
5045 Lee Highway
Bristol VA 24201
9
Washington

- * -

B. J. Whitehurst
Whitehurst Landscapes, Inc.
536 Clearfield Avenue
Chesapeake VA 23320
10
Chesapeake

- * -

E.S. Williams, Jr.
Cherotuck Nurseries, Inc.
111 Deer Keep
Richmond VA 23233
30
Goochland

- * -

Earl Wilson
2901 Holland Road
Virginia Beach VA 23456
5
Virginia Beach

- * -

Joan Wilson
Jim's Greenhouse
Route 2, Box 1485
Chase City VA 23924
2
Mecklenburg

- * -

Ralph S. Woodruff
Yule Log X-mas Tree Farm
7308 Lois Lane
Lanham MD 20706
5

- * -

M,N & C Wulin
Hickory Hill Nursery
Route 1, Box 390-A
Fishersville VA 22939
27
Augusta

- * -

T.E. Zeiger
Zeiger & Sons Greenhouse
Route 1, Box 180
Cape Charles VA 23310
4
Northampton

- * -

Gianni Zonin
Barboursville Winery, Inc
PO Box F
Barboursville VA 22923
5
Albemarle

- * -

Michael Winesett
Winesett Nursery
1853 Plane Circle
Virginia Beach VA 23454
1
Virginia Beach

- * -

Frank Worrell
Kings Dominion Nursery
Route 1, Box 166
Doswell VA 23047
15
Hanover

- * -

William Yagle
Yagle Nursery, Inc.
18 Sawyer Drive
Salem VA 24153
24
Salem

- * -

Mr. Mark A. Zettel
Azalea Acres Nursery & L.S.
6401 Wolf Shoals Road
Fairfax Station VA 22039
2
Fairfax

- * -

Dr. Lloyd Zurbrigg
708 Noblin Street
Radford VA 24141
2
Radford

- * -

William Winn, Jr.
Winn Nursery of VA., Inc.
6926 Granby St.
Norfolk VA 23505
215
Norfolk

- * -

Robert D. Wright
300 Neil Street
Blacksburg VA 24060
1
Montgomery

- * -

Charles F. Young
Glenwood Nurseries & Garden Cen.
Box 12 Creighton Road
Richmond VA 23223
120
Henrico

- * -

Mr. John D. Zirkle
Zirkle's Evergreens & L.S.
Route 2, Box 21-A
Elkton VA 22827
5
Rockingham

Appendix D. Yardwaste Equipment Manufacturers and Vendors (listing does not constitute endorsement).

MATERIALS PREPARATION

Bandit Industries
6750 Millbrook Rd.
Remus, MI 49340
517-561-2270

Fuel Harvesters Equipment
12759 Loma Rica Dr.
Grass Valley, CA 95945
916-272-7664

Iggesund Recycling
P. O. Box 380
Nissawa, MN 56468
218-963-4343

Jones Manufacturing
Rt. 1, Box 80
Beemer, NE 68716
402-528-3861

Lindig Manufacturing
Box 106
St. Paul, MN 55113
612-633-3072

Promark Products, Inc.
330 9th Ave.
Industry, CA 91746
818-961-9783

Recycling Systems
P. O. Box 364
Winn, MI 48896
517-866-2800

Stumpmaster, Inc.
P. O. Box 103
Rising Fawn, GA 30738
404-462-2445

Valby Woodchippers
Northeast Implement Corp.
Box 402, Spencer, NY 14883
607-589-6160

Farmhand, Inc.
6421 Hazeltine Blvd.
Excelsior, MN 55331
612-474-1941

The Heil Co.,
Engineered Systems Div.
P. O. Box 593
Milwaukee, WI 53201
414-647-3333

Jacobson, Inc.
2445 Nevada Ave. North
Minneapolis, MN 55427
612-544-8781

Lindemann Recycling
500 Fifth Ave., Suite 1234
New York, NY 10110
212-382-0630

Olathe Manufacturing, Inc.
100 Industrial Parkway
Industrial Airport, KS 66031
913-782-4396

Recomp, Inc.
1500 East 79th St., Suite 102
Bloomington, MN 55420
612-854-6211

Shredding Systems, Inc.
P. O. Box 869
Wilsonville, OR 97070
503-682-3633

Universal Engineering, Div.
of Pettibone Corp.
800 First Ave., NW
Cedar Rapids, IA 52405
319-365-0441

West Salem Machinery Co.
P. O. Box 5288
Salem, OR 97304
503-364-2213

COMPOST TURNERS

Brown Bear Corp.
P. O. Box 148
Lenox, IA 50851
515-333-4551

Eagle Crusher Co., Inc.
(Cobey Composter)
4250 S.R. 309
Galion, OH 44833
419-468-2288

Resource Recovery Systems
of Nebraska, Inc.
Rt. 4
Sterling, CO 80751
303-522-0663

Kolman/Athey
P. O. Box 806
Sioux Falls, SD 57101
605-336-2610

Scarab Manufacturing
Rt. 2, Box 40
White Deer, TX 79097
806-883-7621

Scat Engineering
P. O. Box 266
Delhi, IA 52223
319-922-2981

Wildcat Manufacturing Co.
Box 23
Freeman, SD 57029
605-925-4512

FINISHING EQUIPMENT

The Heil Co.,
Engineered Systems Div.
P. O. Box 593
Milwaukee, WI 53201

Hobbs-Adams Engineering
1100 Holland Rd.
Suffolk, VA 23434
804-539-0231

Lindemann Recycling
500 Fifth Ave.
New York, NY 10110
212-382-0630

Lindig Manufacturing
Box 106
1877 West County Rd.
St. Paul, MN 55113
612-633-3072

Parker Manufacturing, Inc.
18012 Bothell Highway, SE
Bothell, WA 98012
206-486-3547

Powerscreen of America
11300 Electron Dr.
Louisville, KY 40299
502-255-5330

Recycling Systems
P. O. Box 364
Winn, MI 48896
517-866-2800

Resource Recovery Screens
P. O. Box 32035
Detroit, MI 48232
519-977-9852

Royer Industries
P. O. Box 1232
Kingston, PA 18704
717-287-9624

West Salem Machinery Co.
P. O. Box 5288
Salem, OR 97304
503-364-2213