

# Horticultural Engineering

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Double polyethylene film greenhouse.

## NJ MULTI-STATE NURSERY AND GREENHOUSE FILM RECYCLING PROGRAM

New Jersey's 2003 nursery and greenhouse film collection and recycled program will be held for the seventh year in a row. New Jersey growers can take their nursery and greenhouse film to two regional collection sites. Film will be accepted at the Cumberland County Solid Waste Complex in Deerfield, Cumberland County, and the Occupational Training Center in Mt. Holly, Burlington County. The Mt. Holly site will also accept film from out-of-state growers. Both facilities are accessible from major state highways.

New Jersey's film recycling program has served as a model for other states. To date growers have recycled almost 2.4 million pounds of film. During the 2002 film-recycling program, growers recycled almost 238 tons of used film, a 24 percent increase over the 2001 tonnage. More important, this is the largest tonnage of film recycled since the program was initiated in 1997.

Each film collection site has specific procedures that must be followed when film is transported to the site. In addition, each site has its own collection dates and tipping fees. Any grower, New Jersey or otherwise, interested in recycling their used nursery or greenhouse film should contact the collection site to determine the particular procedures that must be followed.

According to the NJ Department of Environmental Protection's Bureau of Hazardous Waste Regulations, the vehicles used to transport the greenhouse and nursery film intra or interstate are not required to be licensed by NJDEP so long as the used film is transported directly to one of the two collection sites participating in New Jersey's agricultural film recycling program.

Both white and clear nursery film and clear multi-season (two-year, three-year, and four year) greenhouse covers can be recycled. Film **MUST** be free of lathing, staples and saran. Loads containing other agricultural plastics, such as bags, mulch film, shrink film, stretch film or ground cover film, will be rejected at the collection sites. Historically, New Jersey growers have done a tremendous job of maintaining good quality control on the film they recycle. Out-of-state growers must implement the same quality control measures to insure the integrity of NJ's film-recycling program. In 2002 the collection sites indicated that growers were getting lax in

their quality control and trying to deliver "dirty" film to the collection sites. Growers are reminded that the collection sites have the right to reject any load they deem does not meet quality control.

For additional information on the nursery and greenhouse film-recycling program, growers can contact the two collection sites, the NJ Nursery & Landscape Association at (609) 291-7070, or Karen Kritz at (609) 984-2506 or email at Karen.Kritz@ag.state.nj.us.

## **NEW JERSEY NURSERY & GREENHOUSE FILM COLLECTION SITES FOR 2003**

### **CUMBERLAND COUNTY SOLID WASTE COMPLEX**

**COLLECTION DATES:** February 18, 2003 through September 2, 2003

**ACCEPTS ONLY FILM FROM NEW JERSEY**

**LOCATION:** Cumberland County Solid Waste Complex  
169 Jesse Bridge Road  
Deerfield, New Jersey  
Located off Route 55 Exit 29 (Sherman Avenue-Route 552)

**Contact:** Dennis DeMatte, Jr. (856) 825-3700

Prior to delivery of the film, all growers **MUST** call the Cumberland County Improvement Authority to establish an account with the Authority. Growers using a licensed solid waste hauler **MUST** inform the Authority prior to delivery in an effort to maintain proper billing and documentation.

**Hours of Operation:** Monday-Friday 7:30 am - 3:30 pm, Saturday by appointment only

**Tipping Fee:** \$20.00 per ton

#### **Drop-off Requirements:**

- Film must be rolled into manageable bundles for ease of loading and unloading
- If grower chooses to tie the bundle (not required), the tie **MUST** be made of greenhouse or nursery film.
- Material **MUST** be free from all debris including wood, shrink wrap, nails and any other material foreign to said film.
- Film that is dirty or not properly prepared will be rejected.
- Additional services are available on a case-by-case basis. Please contact the Authority with specific needs.

### **BURLINGTON COUNTY OCCUPATIONAL TRAINING CENTER**

**COLLECTION DATE:** February 18, 2003 through September 2, 2003

**ACCEPTS FILM FROM NEW JERSEY AND OUT-OF-STATE GROWERS**

**LOCATION:** Occupational Training Center of Burlington County  
130 Hancock Lane  
Mt. Holly, New Jersey  
Located off NJ Turnpike Exit 5 or Rte. 295 Exit 47A

**Contact:** Kevin Carducci (609) 267-6889 ext. 160

**Hours of Operation:** Monday - Friday 8:00 am – 4:00 pm

**Tipping Fee:** \$25.00 per ton payable by check to OTC

#### **Drop-off requirements:**

- Film must be bundled and tied (the tie **MUST** be made of greenhouse or nursery film) for ease of loading and unloading.
- Material **MUST** be free of any debris including, but not limited to, wood, dirt, stone, etc.

- Film that contains any material other than nursery or greenhouse film will be rejected by the collection site.

## **COLLECTION & BUNDLING GUIDELINES**

Growers are encouraged to maintain a quality control program when removing the film and preparing it for storage or delivery to the collection sites. In order to market the film, the collection sites must be able to provide an ample supply of quality material. Grower cooperation is imperative in order to continue the success and future of the program. Below are steps that **MUST** be followed for the film-recycling program.

### **QUALITY CONTROL**

- Film should be cut just above the lathe board in order to insure that no staples or wood is commingled with the film.
- Most collection sites require that the film **MUST** be rolled. For ease of handling, the film should be rolled up as soon as it is removed from the structure. The rolled film must be no wider than 4-5 feet (like a sausage). It may be necessary to cut the length of the film for ease of handling.
- The bundled film **MUST** be tied and **ONLY** the same type of film in the roll should be used to tie it. **DO NOT** use twine, wire, non-nursery/greenhouse film, etc. If anything other than nursery/greenhouse film is used to tie the bundled film, the load will be rejected (see sketch on next page for bundling procedure options A & B).
- Every step should be taken to avoid picking up excess soil when the film is removed from the structures, rolled, stored or prepared for delivery to the collection site.
- Only nursery and greenhouse film will be accepted at the collection sites. No bags, mulch film, shrink film, stretch film, or ground cover film will be accepted.
- Film **MUST** be free of foreign material: lathing, wood, staples, paper, stone, saran tape, etc. The approved collection sites will reject any loads that contain material other than nursery or greenhouse film.

### **STORING THE FILM FOR FUTURE OFF-SITE RECYCLING**

If a grower misses New Jersey's collection period, the rolls of film can be stored until the next collection program is in place. In order to assure that the material will maintain its quality over the winter months, the steps listed below must be followed.

- The rolls cannot be in contact with the soil or placed on stone. They must be stored on a concrete pad or on pallets. Storing the film on soil or stone will increase the chance of soil or stones contaminating the load of film when it is prepared for delivery to the collection site.
- The best place to store the rolls of film is inside a building. However, if an area of a building cannot be designated for this purpose, the material can be stored outside if it is covered. In order to eliminate the accumulation of water in the rolls, they **MUST** be covered with some type of tarp or plastic. The film, which is removed from the structures, can be used to cover the rolled film and the covering can then be bundled and tied and recycled when the material is delivered to the collection site. If a tarp or non-greenhouse/nursery film is used to cover the rolls, it must be removed prior to delivery of the rolls of film to the collection site.
- All quality control measures outlined earlier must be followed.

### **TRANSPORTATION**

- A grower or a commercial contractor may transport film to the collection sites. If a trash dumpster is used to transport the rolls of film, remember that only nursery and green-

house film is allowed - no other plastic material or refuse. If there are any contaminants in the load, the entire load may be rejected by the collection site.

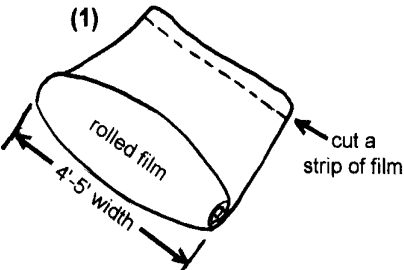
- A solid waste transport permit from the New Jersey Department of Environmental protection IS NOT required to transport recyclable materials to the collection site.

**FOR ADDITIONAL QUESTIONS CONTACT**

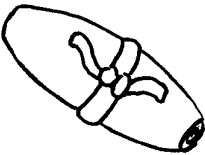
The New Jersey Nursery & Landscape Association at (609) 291-7070 or email at njnla1@aol.com, or Karen Kritz at (609) 984-2506 or Karen.Kritz@ag.state.nj.us.

**NURSERY & GREENHOUSE FILM BUNDLING PROCEDURE**

**OPTION A**



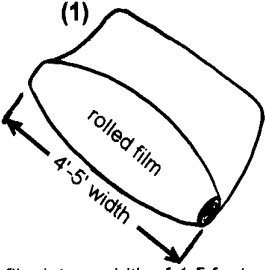
(1) Fold the film into a width of 4-5 feet, roll the film up and then cut off a strip of film from the end of the roll...



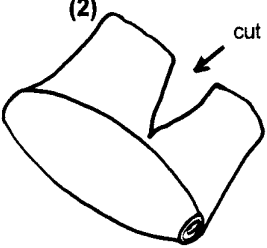
(2) and use the strip of film to tie the bundle.

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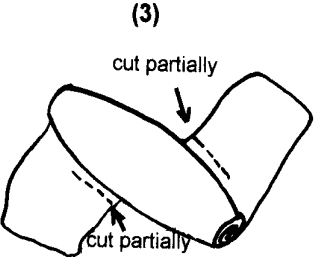
**OPTION B**



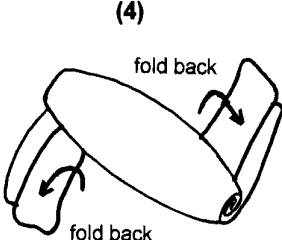
(1) Fold the film into a width of 4-5 feet and roll the film into a bundle...



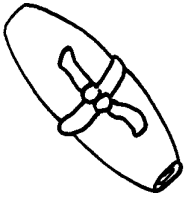
(2) cut the film down the center (the length of the cut will be determined by the diameter of the bundle)...



(3) roll one side of the cut film back under the bundle, cut the film partially (approx. half way)...



(4) fold both pieces of the film back...



(5) and tie the bundle.

The USDA Economic Research Service regularly publishes agricultural statistical data (Table 1). The most recent data (2001) shows the size of the greenhouse/nursery industry in the US compared to all other commodities. The data do not distinguish between greenhouse and nursery production. It is clear that this segment of the agricultural industry remains of significant importance throughout the country, despite significant pressures from abroad.

Table 1. Selected 2001 agricultural statistics data. The total value of cash receipts for the entire US for Greenhouse/Nursery was \$13,794,634,000, which was 6.8% of the value for all US commodities.  
Source: Economic Research Service, USDA, Washington, DC.

State	Rank in each state for Greenhouse/Nursery in the top 25 of agricultural commodities	Value of Greenhouse/Nursery cash receipts (Thousands of \$)	Percent of state's total farm receipts	Percent of the total US value for Greenhouse/Nursery
CA	2	2,851,339	11.0	20.7
FL	1	1,517,989	23.7	11.0
TX	2	1,225,244	8.9	8.9
NC	3	1,119,416	14.5	8.1
OR	1	842,013	27.0	6.1
OH	4	568,105	12.1	4.1
MI	2	501,110	14.4	3.6
WA	6	347,378	6.7	2.5
PA	4	331,608	7.4	2.4
NY	2	315,283	9.2	2.3
<b>NJ</b>	<b>1</b>	<b>306,264</b>	<b>37.3</b>	<b>2.2</b>
MD	2	282,666	17.7	2.0
SC	2	268,407	16.3	1.9
IL	6	267,520	3.5	1.9
GA	6	259,141	4.7	1.9
AL	4	221,137	6.3	1.6
CO	6	207,237	4.4	1.5
TN	4	199,150	9.2	1.4
WI	4	185,972	3.2	1.3
CT	1	183,043	38.4	1.3
VA	5	182,447	7.5	1.3
IN	8	138,440	2.7	1.0
MA	1	135,183	36.9	1.0
OK	7	119,093	3.0	0.9
UT	5	62,496	5.6	0.5
NM	4	57,697	2.6	0.4
NH	1	54,600	35.1	0.4
DE	4	31,300	3.7	0.2
RI	1	29,950	63.1	0.2

## **BE VERY CAUTIOUS USING UNVENTED HEATERS IN GREENHOUSES**

*Modified from an original publication by Dr. George A. Duncan, Extension Agricultural Engineer, University of Kentucky*

Unvented heaters are sometimes used in greenhouses as a temporary source of heat, for carbon dioxide enrichment, or as a regular heat source. Unvented heaters are heaters that have no vent to the outside and release all combustion gases directly into the greenhouse. There are significant dangers and limitations to using heaters under these conditions. Kerosene and fuel oil are more likely than natural and propane gas to produce combustion gases that are harmful to plants (and humans) if present in sufficient quantities. These combustion gases include: ethylene, sulfur dioxide, nitrous oxide and carbon monoxide. A properly adjusted burner may not produce any of these harmful gases, but not all heating equipment is regularly and properly maintained. The combination of dust, moisture, and/or rust in greenhouse environments can result in blockage of gas orifices and combustion air passages resulting in improper combustion and production of noxious gases. Frequent start-up (cycling) of the burner can also increase the production of noxious gases. The level of oxygen can be depleted over several hours of continuous operation thus starving the combustion process of adequate oxygen and contributing to noxious gas production. In some cases, leaks around vents, fan shutters, and doors provide adequate oxygen supply. Some growers make a small opening near the heater to provide sufficient make-up air. However, this does not ensure that noxious combustion gases are removed from the greenhouse environment.

How much make-up air is required? The combustion of natural gas (propane is similar) requires approximately 1,000 cubic feet of air for each 100,000 Btu/hr (1 therm) of heat produced. Thus, a greenhouse with 200,000 to 400,000 Btu/hr of heating capacity requires 2,000 to 4,000 cubic feet of fresh air every hour. But isn't it a waste of energy to have to vent this warm inside air just to bring in fresh air? Not really. Heating this amount of make-up air from 25 to 70°F (typical greenhouse conditions in the spring) requires approximately 1,750 to 3,500 Btu/hr. Standard heating system specifications require one square inch of fresh air opening for every 2,000 Btu/hr of heating capacity. Some growers use flexible air ducts or tubing to provide fresh air from the outside to a point near the heater. This may appear to be sufficient, but the problem is that this does not create an exhaust vent opening to let interior air out. In fact, as fuel is burned it expands the air during combustion, making it harder for fresh make-up air to enter the greenhouse.

Ethylene (colorless, odorless) is one of the combustion gases that can seriously affect plants. Ethylene injury can be very subtle, and may present itself long after ethylene was released in the greenhouse. Sulfur dioxide can be produced as a byproduct of burning fuels containing sulfur. Symptoms of noxious gas exposure include curling of leaves similar to chemical injuries and/or formation of necrotic spots on the leaves. The stage of plant development greatly affects the severity of the symptoms. Not all plant species are equally affected by noxious gas exposure.

If unvented heaters **MUST BE USED** in greenhouses, the following precautions need to be taken:

- Use the cleanest fuel type possible, preferably natural or propane gas. Kerosene fuel heaters are very likely to cause plant injury if they are used for extended periods of time.
- Carefully maintain the burner and make-up air openings.
- Provide a fresh air inlet to the heater and some means for heated air to escape. Provide approximately one square inch of make-up air opening for every 2,000 Btu/hr of heater capacity. Or use small centrifugal fans when the heater is operating to provide fresh air to a point near the heater. Remember: Unvented heaters are unsafe to operate for extended

periods of time.

- Have a person with good smell and eye sensory capabilities visit the greenhouse periodically during the heating season. If a smell or other sensation is detected, take corrective action promptly. (Ventilate the space, reduce the amount of heating and/or install a cleaner burning heater, preferably a vented unit.)
- A definitive test would be to take samples of the greenhouse air and have a qualified air pollution laboratory analyze the samples for noxious gas components.

*Remember: All combustion type heaters used for space heating must be vented to the outside with an approved exhaust stack (chimney) that extends at least 24 inches above the ridge of the greenhouse or the highest adjacent structure.*

Separated combustion heaters are heaters that bring in outside air for the fuel combustion process, and return all the combustion gasses to the outside environment. Usually, a duct brings make-up air to the heater and the chimney transports the combustion gasses to the outside. These heaters are designed so that none of the combustion gasses are ever allowed to be released inside the greenhouse, completely eliminating the danger of noxious gasses causing plant injuries. Despite the fact that these separated combustion heaters are a little more expensive, it is obvious that they are the preferred choice for all greenhouse space heating applications.

## **SHORT ANNOUNCEMENTS**

### *NJ Greenhouse Survey*

Rutgers Cooperative Extension will be conducting a NJ greenhouse industry survey this spring. We are in the process of combining various mailing lists in order to be able to reach all New Jersey greenhouse growers (approximately 350). The goals of the survey are to provide information about the economic situation of NJ growers, as well as determine what important issues are impacting our industry. With the data provided by the survey, we plan to organize an extension meeting where extension agents and growers will be presented with useful information to help them address the most pressing industry challenges. We plan on inviting several experts and ask them to present workable solutions. Funding for this survey was provided by a grant from Rutgers Cooperative Extension through the Department of Extension Specialist. When you receive your survey in the next couple of weeks, please take a few minutes to complete the questionnaire and mail your answers back to us. Your answers will help us plot directions for future research and outreach activities, and therefore, allow you to have a voice in this process. Your cooperation is necessary and much appreciated!

### *Mechanical Ventilation Fact Sheets*

The following fact sheets are now available through Rutgers Cooperative Extension:

- Evaluating Greenhouse Mechanical Ventilation Systems (E277)
- Instruments for Monitoring the Greenhouse Aerial Environment (E276)
- Principles of Evaluating Greenhouse Aerial Environments (E275)

These fact sheets can be ordered from the RCE Publication and Distribution Center (732-932-9762) or can be downloaded by visiting the following web site:  
<http://www.rce.rutgers.edu/pubs/>

**RUTGERS COOPERATIVE EXTENSION  
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US Botanic Garden, Washington, DC.

**HORTICULTURAL ENGINEERING**

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**Horticultural Engineering Web Site**

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**Upcoming Meetings, Shows, etc.**

United States Botanic Garden  
Washington, DC  
year-round  
<http://www.usbg.gov/>

New York Botanic Garden: Orchids  
New York, NY  
February 28-March 30, 2003  
<http://www.nybg.org/events/orchids.html>

Philadelphia Flower Show  
Philadelphia, PA  
March 2-9, 2003  
<http://www.theflowershow.com>

Royal Greenhouses  
Brussels, Belgium  
April 16-May 4, 2003  
[http://www.monarchie.be/site/nl/visites\\_serres.html#visite](http://www.monarchie.be/site/nl/visites_serres.html#visite) (site in Dutch)

Ohio Short Course  
Columbus, OH  
July 12-16, 2003  
<http://www.ofa.org>

HortiFair (NTV)  
Amsterdam, the Netherlands  
November 5-8, 2003  
<http://www.hortifair.nl>