

2012 GEORGIA PEST MANAGEMENT HANDBOOK
Commercial Edition
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Edited by

Paul Smith, Extension Entomologist

With contributions from the Departments of

Agricultural Engineering, Crop and Soil Sciences, Entomology,
Forestry and Natural Resources and Aquaculture and Fisheries, Horticulture, and Plant Pathology

The University of Georgia Cooperative Extension
College of Agricultural and Environmental Sciences

The thirty-third edition of the *Georgia Pest Management Handbook* gives current information on selection, application, and safe use of pest control chemicals. The Handbook has recommendations for pest control on farms, around homes, urban areas, recreational areas, and other environments in which pests may occur. Cultural, biological, physical, and other types of control are recommended where appropriate.

Additional information on control of insects, plant diseases, and weeds is available in bulletins and circulars published by Cooperative Extension. Your county agent will provide copies upon request. Free publications are also available at www.caes.uga.edu/publications.

Recommendations are based on information on the manufacturer's label and on performance data from Georgia research and Extension field tests. Because environmental conditions and methods of application by growers vary widely, suggested use does not imply that performance of the pesticide will always conform to the safety and pest control standards indicated by experimental data.

This publication is intended to be used only as a guide. Specific rates and application methods are on the pesticide label. Refer to the label when applying any pesticide. Please send improvement suggestions to pfsmith@uga.edu.

COPIES ARE AVAILABLE AT \$30.00 EACH. Visit us online at www.ent.uga.edu/pmh. Please make check or money order payable to the UNIVERSITY OF GEORGIA and send to:

OFFICE OF COMMUNICATIONS

Cooperative Extension
126 Hoke Smith Building
The University of Georgia
Athens, Georgia 30602

Include your name, street address (UPS will not deliver to a Post Office Box), city, state and zip code. Credit card orders can be made by calling (706) 542-2657 or by faxing order information to (706) 542-0817.

PESTICIDE EMERGENCIES

Paul Smith, Extension Entomologist

POISON CONTROL CENTER (HUMAN OR ANIMAL)
National Poison Control Hotline (Spanish speakers available)
(800) 222-1222

SPILLS
(Dept. of Natural Resources)
(800) 241-4113

Avoid emergencies/Prepare for emergencies.

1. Maintain a communication link at your pesticide storage and mix/load site.
2. NEVER handle 'DANGER' pesticides or fumigants alone.
3. Closely supervise fumigant use. Have protective clothing available in case a rescue is needed.
4. Maintain contact with anyone using a pesticide with the signal word 'DANGER'.
5. Keep Material Data Safety Sheets readily accessible for every pesticide you use.
6. Keep protective clothing readily available wherever pesticides are stored or handled.
7. Have water available to wash pesticides from skin or eyes.
8. Store and handle pesticides in areas where spills will be contained.
9. Assemble and maintain a spill kit wherever you handle pesticides.
10. Make sure that all employees understand how to handle pesticide emergencies.
11. Be familiar with the first aid instructions on the pesticide label.
12. NEVER store pesticides in food or drink containers.

Symptoms of pesticide poisoning: nausea, vomiting, diarrhea, cramps, headache, dizziness, weakness, confusion, sweating, chills, chest pains, difficulty breathing, unconsciousness. If you have any of these symptoms while you are handling pesticides, suspect pesticide poisoning.

FIRST AID FOR POISONING

1. Stop the pesticide exposure as quickly as possible. **CALL 911 IF SYMPTOMS ARE SERIOUS! CALL POISON CONTROL (800-222-1222) FOR FIRST AID INFORMATION. YOU WILL NEED THE PESTICIDE LABEL.**
2. If the victim is not breathing, administer artificial respiration at once.
3. Consult the pesticide labeling if possible. Directions for first aid will be on the front panel.
4. Otherwise, follow these guidelines.

SKIN: drench skin as quickly as possible with plenty of water. Any moderately clean water can be used if not contaminated with pesticides. Remove contaminated clothing. Wash with soap if available. Dry victim and treat for shock. If skin is burned, cover with clean, loose bandage or cloth. Do not apply ointments to burned skin.

EYE: Wash eye quickly but gently. Rinse eye with clean water for at least 15 minutes.

INHALED: Move victim to fresh air. Warn other nearby people. Loosen clothing that restricts breathing. Administer artificial respiration if necessary.

SWALLOWED: Rinse mouth with plenty of water. Give large amounts of water or milk (up to one quart) to drink. Consult the label before you induce vomiting. Do not give liquids or induce vomiting to anyone who is unconscious or convulsive.

5. Take the pesticide label with you to the doctor or hospital. **DO NOT** transport pesticides in the passenger compartment of the vehicle.

PESTICIDE SPILLS

Assemble a spill kit that contains the following items.

1. Protective equipment indicated on pesticide label.
2. Absorbent material to soak up liquids (cat litter, sand, sawdust, dirt).
3. Scoop to pick up contaminated absorbent material.
4. Container for contaminated absorbent material (e.g., heavy duty plastic bag).

You may apply the contaminated absorbent material according to the pesticide label. Do not exceed labeled rates.

Large spills, leaks, pesticide fires: Call Georgia DNR EPD Response Team (800) 241-4113

Spills on public roads or other public areas: Georgia State Patrol *GSP (*477) on mobile phone

Smaller spills.

1. DO NOT HOSE DOWN SPILLS!
 2. Protect yourself and others.
 3. Stop the spill sources.
 4. Confine the spill with a dike of earth or other materials. Protect water sources.
 5. Absorb liquids with cat litter, sand, earth, etc.
 6. Scoop up contaminated materials. Store securely.
 7. Neutralize contaminated site with bleach, activated charcoal, hydrated lime, or by removing contaminated soil.
 8. Absorb any liquids used during neutralizing.
 9. Contaminated absorbent materials or soil may be land-applied according to the pesticide label.
-

HEAT STRESS

Avoid heat stress.

1. Acclimate to hot weather or new strenuous activities slowly.
2. Drink plenty of water or sports drinks.
3. Take frequent breaks during hot weather.
4. Plan strenuous activities for the cooler part of the day.

Symptoms of heat stress: sweating, nausea, headache, confusion, loss of coordination, dry mouth, fainting. Severe heat stress (heat stroke) is VERY dangerous.

The EPA Guide to Heat Stress in Agriculture is available through your local Extension office.

FIRST AID FOR HEAT STRESS

1. **CALL 911 IF SYMPTOMS ARE SERIOUS!**
2. Move the victim to a cooler area immediately.
3. Cool the victim as quickly as possible by splashing cool water on them or immersing them in cool water. Do not immerse anyone who is unconscious, convulsive, or confused.
4. Remove all protective equipment or clothing that is keeping the victim too warm.
5. If the victim is conscious, have them drink as much cool water as possible.
6. Keep the victim quiet. Get medical advice.

IMPORTANT TELEPHONE NUMBERS

Paul Smith, Extension Entomologist

EMERGENCY NUMBERS

In an emergency dial 911, especially if the person is unconscious, has trouble breathing, or has convulsions.

POISON CONTROL CENTER (HUMAN OR ANIMAL)

National Poison Control Hotline (Spanish speakers available)

(800) 222-1222

Physician _____

Ambulance _____

FIRES, SPILLS, LEAKS, ETC.

Georgia DNR Environmental Protection Division Response Team (pesticide fires, spills, leaks) **(800) 241-4113**

County Police or Sheriff _____ City Police _____

Georgia Highway Patrol Post (*GSP (*477) for mobile phones) _____ Fire Department _____

ENDANGERMENT OF GAME OR FISH

Georgia Department of Natural Resources (Non-game endangered species) **(800) 241-4113**

U.S. Fish and Wildlife Service **(800) 344-WILD**

PHONE NUMBERS FOR PESTICIDE INFORMATION (NON-EMERGENCY)

University of Georgia Cooperative Extension

(voice) **(706) 542-2816** or **(706) 542-2264** or (fax) **(706) 542-3872**

email: pfsmith@uga.edu

PESTICIDE INFORMATION

National Pesticide Information Center (NPIC), Oregon State University - General information on toxicology, environmental hazard, etc. (M-F, 10:30 a.m. - 6:30 p.m. EST) npic@ace.orst.edu, **(800) 858-7378**

Pesticide Manufacturer - The telephone number should be listed on the pesticide label

CropLife America - General information about the pesticide industry (M-F, 9:00 a.m. - 5:00 p.m. EST) **(202) 296-1585**

National Response Center - Refers caller to proper government agency for hazardous materials **(800) 424-8802** (Voice/TTY)

PESTICIDE DISPOSAL

Georgia Department of Agriculture **(800) 282-5852**

EPA Hazardous Waste Hotline (Superfund) **(800) 424-9346**

HAZARD COMMUNICATION - Workplace Assistance

OSHA **(800) 321-OSHA (6742)** TTY **(877) 889-5627**

Regional IV OSHA Office Alliance in Atlanta **(404) 562-2277**

EPA SAFE DRINKING WATER HOTLINE - Interprets residue data and gives EPA drinking water regulations. **(800) 426-4791**

Or call your local Health Department or Sanitarian. County _____ City _____

IMPORTANT TELEPHONE NUMBERS (continued)

ENFORCEMENT OF PESTICIDE LAWS

Georgia Department of Agriculture, Pesticides Division (800) 282-5852

EPA Region IV Pesticides Section (404) 562-8956

Applicator certification to use restricted-use pesticides (800) 282-5852

Structural pest control certification (800) 282-5852

Safety/Training/Information - Dr. Paul Smith (UGA Cooperative Extension) (706-542-2264), pfsmith@uga.edu

WEBSITES WITH PESTICIDE INFORMATION

Ga. Integrated Pest Management (IPM) http://ipm.ent.uga.edu	Pesticide labels/MSDS from a range of companies. Daily updates at www.CDMS.net
University of Georgia Cooperative Extension http://extension.uga.edu	Crop Protection & Turf/Ornamental References - C&P Press www.greenbook.net
Georgia Department of Agriculture - Pesticide Division http://agr.georgia.gov - click on Divisions and Plant Industry	EPA Pesticide Product Information http://ppis.ceris.purdue.edu
Pesticide Licensing http://agr.georgia.gov - click on Divisions and Plant Industry	EPA List of Restricted-Use Pesticides www.epa.gov/oppr001/rup
American Crop Protection Association www.croplifeamerica.org	Pesticide Risks http://extoxnet.orst.edu
Pesticide Action Network North America www.panna.org	EPA Pesticide Safety Programs/Worker Protection Standard www.epa.gov/agriculture
Pesticides and Cancer http://pestmanagement.rutgers.edu/NJinPAS/postings/EPA-cancerchem704.pdf	EPA Office of Pesticide Programs www.epa.gov/pesticides/
U.S. Fish & Wildlife Service: Endangered Species www.fws.gov	EPA Agriculture Compliance Center: www.epa.gov/agriculture
National Pesticide Telecommunications Network http://npic.orst.edu	Georgia Organics www.georgiaorganics.org
USDA National Organic Program www.ams.usda.gov/nop	

Worker Protection Standard

The U.S. EPA Worker Protection Standard (WPS) requires agricultural employers to provide four basic protections for their employees. 1) Training: employees must receive pesticide safety training. 2) Information concerning pesticides applied in the work area must be posted in a central location. 3) Employees must be excluded from treated areas or provided proper training and safety equipment if they may be exposed to pesticides. 4) Employers must supply decontamination sites (soap, water, etc.) for workers. Emergency assistance must be available for any employee injured by pesticides. Refer to the EPA Worker Protection Standard for Agricultural Pesticides - How to Comply for details (available at www.epa.gov/pesticides/safety). Additional information is available from the Georgia Dept. of Agriculture (800-282-5852) or University of Georgia Cooperative Extension (1-800-ASK-UGA1).

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ABBREVIATIONS AND EQUIVALENTS

FORMULATIONS¹

a.i. = active ingredient	EC = emulsifiable concentrate	S = sprayable powder
AC = aqueous concentrate	EL = emulsifiable liquid	SC = spray concentrate
AS = aqueous suspension	F = flowable	SP = soluble powder
DF = dry flowable	FC = flowable concentrate	W = wettable powder
DG = dispersible granules	G = granules	WDL = water dispersible liquid
B = bait	L = liquid	WM = water miscible
D = dust	LC = liquid concentrate	WP = wettable powder
E = emulsifiable	M = microencapsulated	

¹ Numbers preceding abbreviations for liquid formulations equal pounds of active ingredient per gallon (e.g., 4EC = 4 lbs./gal. emulsifiable concentrate); numbers preceding abbreviations for solid formulations equal percent active ingredient by weight (e.g., 50WP = 50 percent wettable powder).

METHOD OR TIME OF APPLICATION

CR = cracking stage	PEI = preemergence incorporated	PRE = preemergence
LV = low volume	PO = postemergence	PT = post transplant
NS = nonselective	POT = postemergence over-the-top	RCS = recirculating sprayer
PDS = postemergence directed spray	PP = preplant	ULV = ultra low volume ²
PE = preemergence on surface	PPI = preplant soil incorporated	WICK = rope wick applicator

² Ultra low volume refers to a total spray volume of one-half gallon or less per acre.

MEASURES AND EQUIVALENTS

tsp.	=	teaspoonful			1 teaspoonful	=	4.9 milliliters
Tbs.	=	tablespoonful	1 Tbs.	=	3 teaspoonfuls	=	14.8 milliliters
fl. oz.	=	fluid ounce	1 fl. oz.	=	2 tablespoonfuls	=	29.6 milliliters
c.	=	cupful	1 c.	=	8 fluid ounces	=	236.6 milliliters
pt.	=	pint(s) (1.04 lb. of water)	1 pt.	=	2 cupfuls	=	473.2 milliliters
pt./100	=	pint(s) per 100 gallons	1 pt./100	=	1 teaspoonful per gallon		
qt.	=	quart(s) (2.09 lbs. of water)	1 qt.	=	2 pints	=	946.4 milliliters
gal.	=	gallon(s) (8.35 lbs. of water)	1 gal.	=	4 quarts	=	2.7854 liters
oz.	=	ounce			1 ounce	=	28.35 grams
lb.	=	pound	1 lb.	=	16 ounces	=	453.59 grams
in.	=	inch	1 in.	=	1000 mils	=	2.54 centimeters (25,400 microns)
ft.	=	feet	1 ft.	=	12 inches	=	30.48 centimeters
yd.	=	yard	1 yd.	=	3 feet	=	91.44 centimeters
mi.	=	mile	1 mi.	=	5280 feet	=	1609 meters (16.09 kilometers)
sq. in.	=	square inch			1 square inch	=	6.45 square centimeters
sq. ft.	=	square feet	1 sq. ft.	=	144 square inches	=	929.03 square centimeters
A.	=	acre	1 A.	=	43560 square feet	=	0.4047 hectare
cu. in.	=	cubic inch			1 cubic inch	=	16.387 cubic centimeters
cu. ft.	=	cubic feet	1 cu. ft.	=	1728 cubic inches	=	0.0283 cubic meter
cu. yd.	=	cubic yard	1 cu. yd.	=	27 cubic feet	=	0.7646 cubic meter
p.p.m.	=	parts per million	1 p.p.m.	=	1000 p.p. billion	=	1 milligram/Kilogram ³
p.s.i.	=	pounds per square inch			1 p.s.i.	=	70.3 grams per cubic centimeter

³ 1 milligram/Kilogram or 1 p.p.m. is equal to 1 milligram/Liter of water.

SUBMITTING SPECIMENS FOR IDENTIFICATION: COLLECTION, PREPARATION AND SHIPMENT

INSECTS

Paul Smith, Extension Entomologist

An important function of the Extension Entomology Department is to identify insect and mite specimens submitted by County Extension Agents. In order to obtain a correct identification, the county agent must collect and submit properly preserved specimens.

All county Extension offices are provided small vials containing a preservative, insect identification forms, and mailing tubes. Most specimens encountered are small enough to be placed in a vial containing preservative (alcohol). When possible, it is helpful to collect and submit multiple specimens of each pest for identification.

Insects may be unidentifiable beyond family or even order level after being crushed or becoming decayed. Large insects such as butterflies, wasps and beetles should first be placed in an insect killing jar and then transferred to a small, crushproof container for mailing.

Never mix moths and butterflies with other insects or put other insects into a killing jar that has previously contained butterflies or moths. Their dust-like scales quickly cover other insects and greatly complicates proper identification.

Mites, thrips, and scale insects should be sent as you would diseased plants because they are easily damaged when handled and their characteristic appearance on the plant is often crucial to identification. If possible, small caterpillars, grubs, and maggots should be sent live in a plastic bag with some of the host material. Sometimes they cannot be identified until they are reared to the adult stage. If these insects cannot be sent in live, place the specimen in a vial with preservative before shipping the sample. All other soft bodied insects, ticks, mites and spiders should be placed in a vial with preservative before shipping the sample.

To obtain rapid, accurate identification of insect specimens, be sure to include the following information:

- (1) Locality (nearest town and county) where specimen was collected.
- (2) Name of collector of specimen.
- (3) Date collected.
- (4) Host plant(s) or whatever the insects were feeding on, if applicable.
- (5) Stage of growth: seedling, blooming, fruiting, one week before harvest, young animal (less than three months old), mature animal.
- (6) Degree of infestation.
- (7) What, if any, chemicals have been applied.

Complete either the Homeowner Insect and Weed Diagnostic Laboratory or Insect ID form as appropriate for the sample. <http://www.caes.uga.edu/departments/ent/upmp/documents/IPMSubmissionForm.pdf>

SHIPPING INSECT SPECIMENS

Address package to the appropriate clinic and/or specialists. All samples submitted from homeowners should be submitted to the UGA Homeowner Insect and Weed Diagnostic Laboratory, 210 Cowart Building, College of Agricultural and Environmental Sciences, Georgia Experiment Station, 1109 Experiment Street, Griffin, GA 30223-1797. All insects submitted dealing with row crops, forage, forestry, apiculture, commercial ornamental and turf, commercial household and structural, man, pets, livestock and poultry should be submitted to one of the following addresses:

Extension Entomology
463 Biological Sciences Building
The University of Georgia
Athens, GA 30602

(all medical, apple, peach, small
fruits, ornamentals, apiculture,
pets, livestock and poultry pests
samples)

Extension Entomology
P.O. Box 8112-GSU
Rosenwald Bldg. - 3rd Floor
Statesboro, GA 30460

(row crop pests samples)

Extension Entomology
Rural Development Center
P.O. Box 1209
Tifton, GA 31793

(row crop pests, pecan, turf,
Christmas trees, forestry pests
samples)

Department of Entomology
Georgia Experiment Station
1109 Experiment Station
Griffin, GA 30223-1797

(all commercial household and
structural pests samples)

GUIDELINES FOR SUBMITTING INSECT SAMPLES USING THE DISTANCE DIAGNOSTICS THROUGH DIGITAL IMAGING SYSTEM

- 1. Provide a scale for the size of the insect.** In many cases, the size of the insect is a critical character for identification. Place a dime in the field of vision so the specialist can tell how big (or small) the insect is.
- 2. Provide supplemental information.**
 - a. Is the client simply curious, or is the insect causing serious damage?
 - b. Where and when was the insect collected?
 - c. How many insects were seen? An exact count is not critical, but the difference between a dozen insects and hundreds can be important.
- 3. Show unique features clearly.** If an insect has very long legs or unusual mouthparts, make sure these features are prominent in a picture. If the color is a key character, the color must be apparent in the submission.
- 4. Provide multiple views of the insect.** Take pictures from the front, top, side, and underside of the insect. Submit some close-ups and some pictures from farther away.
- 5. Use supplemental lighting.** Use office lamps or other lights to provide additional illumination for the pictures.
- 6. Ensure adequate resolution.** It is often impossible to identify small insects through DDDI unless the pictures are taken through a magnifying scope.

PLANT DISEASES

Elizabeth Little, Extension Homeowner IPM Specialist

Plant diagnostic clinics are operated and maintained to provide County Extension offices with diagnoses and educational programming to maximize economic input, promote environmental integrity by targeting pest control management educational efforts and improve the sustainability of agriculture in Georgia. Contact your county Extension office for submission of plant disease samples.

PLANT DISEASE INFORMATION FORMS: Acquisition of complete and accurate information for the completion of the appropriate **PLANT DISEASE INFORMATION FORM** is essential. Particular attention to previous chemical application is stressed. Knowledge of previous control measures can aid the specialist in formulation of the most practical control recommendation.

Blue Forms are required for all commercial specimens. Commercial specimens include Greenhouse, Nursery, Golf Course, Ground Maintenance, Retail Outlet and Landscape. Extension specialists, researchers, and consultants are also required to completely prepare a blue form.

Yellow Forms are required for all Homeowner IPM specimens. Homeowner IPM specimens may include plant diseases for diagnosis.

PLANT SYMPTOMS AND SPECIMEN SELECTION

Wilting, Yellowing or General Decline. If practical, it is best to send the entire plant (leaves, stems, roots). Collect plants that have early disease symptoms. Dig up carefully. **DO NOT PULL UP**---many roots will be lost.

Twig and Branch Blights and Cankers. Select specimens that show recent infection. Include healthy tissues with diseased tissues. **DO NOT INCLUDE TWIGS, ETC. THAT HAVE BEEN DEAD FOR SEVERAL MONTHS. THIS TYPE OF MATERIAL WILL NOT ALLOW PROPER IDENTIFICATION.**

Foliage Diseases. Select leaves that have early and recent infections. Marginal burning of leaves should be sent along with the entire plant if possible. Symptoms of this type usually indicate chemical injury or some type of root disorder (physiological, organic or chemical).

Fruit and Fleshy Plant Organs. Diseases of these structures require special attention. Never select a specimen that is exhibiting advanced stages of decay or disease. Select fresh specimens that exhibit early symptoms.

SHIPPING PLANT DISEASE SPECIMENS

When submitting an entire plant for diagnosis, root systems must be bagged separately to prevent soil from coming in contact with above ground plant parts. Otherwise, place diseased specimens in a plastic bag. **DO NOT ADD ANY MOISTURE.** Place a **DRY** paper towel in the plastic bag with the specimen. This will absorb any excess moisture. Fleshy fruit and vegetables should be wrapped separately. Paper towels are better wrappings, but brown paper and newspaper are good. **KEEP ALL SPECIMENS COOL. DO NOT ALLOW SPECIMENS TO BECOME DRIED OUT AND BRITTLE.**

HOW TO SUBMIT SAMPLES FOR HOMEOWNER PLANT DISEASE DIAGNOSIS

Procedure for submission of homeowner samples:

The Plant Pathology Homeowner physical sample submission is now handled through the UGA Distance Diagnostics through Digital Imaging system. To submit a physical sample for a homeowner, navigate to <http://www.dddi.org/uga/> and login using your username and password. Upon login, select “Plant Pathology” from the side menu. The content pane to the right of the side menu will display the available forms for Plant Pathology. Choose “Digital & Physical Plant Pathology Homeowner.”

The content pane will display the client information form, which is identical to the client information form used for digital sample submissions. Select your client from the “Select Existing Client” box, or enter the client’s information in the “Client Information” form. When you have selected the client, or entered the client information, click “Continue” to go to the sample submission form.

The content pane will display the sample submission form. Enter the appropriate information in the form. Within this screen, you can select whether you are submitting a PHYSICAL, DIGITAL, or PHYSICAL & DIGITAL sample. Please mark the appropriate choice and proceed by filling out the rest of the required information. Take note that all elements designated with an ‘*’ on the form are required to be completed. If one of the questions does not pertain to your situation, enter “NA” or “Not Applicable.”

When you have completed all the information on the form, click “Submit Form” at the bottom of the submission form. If you have left a required form element blank, you will receive an error message. Upon successful submission of the form, you will receive a success message with your sample tracking number and a link to generate a PDF report of your sample information. You must print the PDF/HTML sample report and enclose it with the sample to be mailed to the lab. If you do not print and enclose the PDF with your sample, your sample may not be diagnosed. Mail your physical sample and printed PDF sample report to the lab.

Your diagnosis will be handled through the UGA DDDI system, as well. Upon diagnosis, you will receive an email with your diagnosis. You may view your diagnosis in the DDDI system at any time subsequent to diagnosis.

******THERE IS A \$10 PROCESSING CHARGE FOR ALL PHYSICAL HOMEOWNER SAMPLES (STARTING JANUARY 1, 2007). PLEASE SEND A CHECK PAYABLE TO ‘PLANT DISEASE CLINIC’ ALONG WITH THE SAMPLE.**

Ship specimens Mondays, Tuesdays, and Wednesdays. Samples shipped on Thursdays and Fridays usually require longer to reach the Plant Disease Clinic. This often results in complete decay or drying-out of the specimen; therefore, diagnosis is greatly hindered. Place prepared specimen in a mailing tube. If specimen is too large, put it in an appropriate sized box. Fill out as completely as possible a PLANT DISEASE INFORMATION FORM (blue) for commercial samples. Address with appropriate label and send to either the Athens or Tifton Extension Plant Disease Clinics, depending on the crop involved.

Ship the following COMMERCIAL specimens		Tifton Clinic Address UGA Plant Pathology Department Tifton Plant Disease Clinic Room 116 4604 Research Way Tifton, GA 31793
Corn, Cotton, Peanut, Pecans, Tobacco, Soybeans, Vegetables and Kenaf	▶ To Tifton Clinic	
Ship the following COMMERCIAL specimens		Athens Clinic Address Extension Plant Disease Clinic Cooperative Extension Extension Plant Pathology 2106 Miller Plant Sciences Bldg. University of Georgia Athens, GA 30602
Christmas Trees, Floral Crops, Ornamental Trees and Shrubs, Fruits, Legume Forages, Forestry Trees, Small Grains, Turf, Urban Ornamental Landscape, Mushrooms and Wood Rots	▶ To Athens Clinic	
Ship all HOMEOWNER specimens REGARDLESS OF CROP	▶ To Athens IPM Clinic	Homeowner Clinic Address Extension Homeowner IPM Clinic Extension Plant Pathology 2106 Miller Plant Sciences Bldg. University of Georgia Athens, GA 30602

GUIDELINES FOR SUBMITTING PLANT DISEASE SAMPLES USING THE DISTANCE DIAGNOSTICS THROUGH DIGITAL IMAGING SYSTEM

Elizabeth Little, Extension Homeowner IPM Specialist

The Distance Diagnostics Through Digital Imaging (DDDI) system was created to rapidly transmit digital images with related information and enhance plant pathology diagnostic capabilities through the Internet Imaging System. The objectives of the system are to (1) improve diagnostic return time via the county delivery system, (2) improve crop sustainability and production economics and (3) promote best management and integrated pest management practices for clientele in the state of Georgia. Samples will be accepted only when submitted through county Extension offices.

When imaging and submitting samples:

1. **It is best to initially image the entire plant or sample using the digital handheld camera.** A good overall picture of general symptoms is necessary for diagnosis. Characteristics of the environment in the field or landscape are also useful. **Avoid submitting only closeups of the plant or sample.** Take several images from different angles and select the best one for submission. It's best to go from BIG to small. Submit at least 4 pictures.
2. If the plant symptom is **wilting or general decline**, the roots should be examined using the compound microscope. Symptoms such as these usually indicate root stress, root disease, nematode injury and/or poor cultural care. Use red (acid fuchsin) stain when preparing a microscope slide of the roots. Examine initially at 40x and 100x magnification until fungal structures (hyphae, fruiting bodies and/or spores) are found. Then move to 400x for images to be taken using the camera mounted to the microscope and image capture device.
3. When a **blight** is present with accompanying death or decline of individual twigs or branches the sample should be examined using the dissecting and compound microscope. These symptoms usually are caused by fungal or bacterial canker and/or dieback diseases or possibly chemical or mechanical injury. The twigs or branches sampled should have both living and dead leaves and/or tissue. Initially examine the sample using the stereoscope. Images taken of symptoms and any fruiting structures using the stereoscope are useful in diagnosis. Fruiting structures of possible pathogenic fungi are sometimes present on woody tissue where sap is oozing, in sunken areas and/or near the margin of the canker and/or cambium discoloration. Cut or thinly slice plant tissue containing fruiting structures from these areas to remove the pathogen. Place this material on a microscope slide and with a water droplet and macerate the tissue into tiny pieces. Examine initially using 40x and 100x magnification until fungal structures are detected. Then move up to 400x for images to be taken using the camera mounted to the microscope and image capture device.
4. **Leaf spots** caused by fungal and bacterial pathogens can be diagnosed from a 12-inch branch containing leaves with early infections. In some cases only a few leaves may be needed provided they are in good condition. Leaves with marginal burning usually indicate root stress due to environment, poor cultural care and/or disease. Leaf spots generally are one of the easier problems to diagnose. Use the stereoscope to determine where fruiting structures are present and cut out as small a section from the spot as possible. Macerate this tissue on a microscope slide with a drop of water. Examine the microscope slide initially using 40x and 100x magnification until fungal structures or streaming (bacteria) are found. Move to 400x for images to be taken using the camera attached to the microscope and image capture device.
5. In order to diagnose **problems with fleshy fruit or plant organs**, a good overall image of the symptoms is necessary. Signs of fungi present in handheld and/or stereoscope images are also helpful. If sunken or necrotic areas are present, it may be possible to isolate the causal organism using the compound microscope. Use the stereoscope to determine if any fruiting structures are present. Extract the tissue using a scalpel and macerate the tissue on a microscope slide with a drop of water. Examine initially with the compound scope at 40x and 100x magnification until fungal structures are found. Move to 400x for images to be taken using the camera attached to the microscope and image capture device. Some problems with fleshy fruit or plant organs may be viral, bacterial or nutritional and not require this step.
6. **Turf problems** often require examination of the leaf blades, sheath and roots of the grass. Select a sample that is in intermediate stages of decline (i.e., has both green and brown tissue present). An accurate diagnosis cannot be made from a completely dead (brown) turf sample. Handheld digital camera images or stereoscope shots of the symptoms on the leaf blades and other above ground parts are useful for diagnosis. Signs of the fungus may be present during moist periods. Pathogenic fungi can be isolated from brown areas of the ligule, auricle, sheath, crown and roots. Leaf spots on turfs can be diagnosed much the same as in #4. Use acid fuchsin stain when preparing a slide of the crown and roots. Water may be used for compound microscope examination of above ground parts. Examine initially using 40x and 100x magnification until hyphae and/or spores are found. Then move to 400x for images to be taken using the camera mounted to the microscope and image capture device.

Fill out the sample submission form as completely as possible. Items marked with an asterisk* must be completed for successful transmission of information. Be sure images taken using the image capture device are in .jpg format. File names of images with more than eight characters and/or any spaces will not be accepted by the system.

Technical support and training on the DDDI system are available online at www.dddi.org/html/support.html

PREPARATION, STORAGE, AND SHIPPING OF PLANT SAMPLES FOR VIRUS DIAGNOSIS

Elizabeth Little, Extension Homeowner IPM Specialist

Many of the crops grown in Georgia are susceptible to one or more viruses. There are an estimated 900 viruses that are known to infect plants worldwide. With conducive climate and year-round intensive cultivation of a wide range of field and greenhouse crops, Georgia has its share of virus diseases. Knowing what virus is causing a disease is necessary to develop appropriate management measures. Though certain viruses cause distinctive symptoms on crops they infect, definitive identification is possible only with laboratory testing. Since different viruses produce similar symptoms, and one virus may cause a range of different symptoms, accurate diagnosis may not be possible by visual inspection alone. There are several approaches to unequivocally confirming a particular virus as a cause of a disease. Most of the detection methods require specific equipment and reagents, and trained personnel for processing plant samples. Hence, samples suspected of virus infection need to be sent to a diagnostic laboratory. The success of diagnostic methods in accurately identifying a causative virus greatly depends on the condition of the plant material at the time of testing. Therefore, it is important to properly prepare plant samples for shipping to a diagnostic laboratory.

1. To ensure that the sample(s) will arrive fresh, try to collect the sample the day it is shipped.
2. If the symptoms are on the foliage, collect symptomatic leaves (necrotic spots, ringspots, mosaic, mottling, deformities etc.). Send four or five leaves from each plant.
3. If no obvious symptoms are present but the plant still looks abnormal, send the whole plant (with as much root system as possible). Some viruses reach a higher concentration in roots than the above ground parts.
4. Include a normal looking plant from the same field where the diseased plant was collected. This apparently healthy looking plant will also be included in the diagnostic test to improve the accuracy of the detection method.
5. Blot the sample dry (if it is wet at the time of collection) with a dry paper towel. Wrap the sample with a fresh, dry paper towel and place it in an ordinary plastic or freezer bag.
6. If the sample cannot be mailed the same day it is collected, store it in a refrigerator (4° C) until it is shipped. Do not let the sample(s) get wet, and DO NOT freeze the sample(s). Do not hold samples more than one or two days.
7. Overnight shipping is preferred, but first class mail or a package shipping service that delivers in two to three days is acceptable if the sample does not become dry.
8. If more than one sample is sent, place each sample in a separate labeled bag.

Include the following information in the **Plant Disease Information Form** (blue) with the samples to be tested:

1. The name of the crop, variety or cultivar, age of the crop, location of the field, and the grower's name.
2. Indicate if the abnormal plants are scattered individually in the field or concentrated in one area of the field. If there are concentrated areas, approximately how many and how far apart are they? Were there more abnormal plants along the edges of the field than elsewhere?
3. What other crops are being grown adjacent to the field with abnormal plants?
4. Did you notice any insect activity in the field such as whiteflies, aphids, or thrips?
5. Was the seed bought from a certified source, especially in case of vegetables?
6. When was the last time any chemical (insecticide/herbicide) was applied in or near the affected field? Give details of the chemical(s) applied.

Contact your plant pathology commodity specialist before sending samples.

NEMATODES

Bob Kemerait, Extension Plant Pathologist

- I. WHY SAMPLE:** Nematodes can parasitize virtually all crops and ornamental plants and can cause significant economic damage by reducing both yield and quality. Properly taken samples from small field units can reduce production costs by allowing the grower to eliminate nematode control practices where they are not needed and implement control practices where they are needed. Improper sampling or handling of samples can lead to poor recommendations and economic losses that could have been avoided.
- II. WHEN TO SAMPLE:** The timing of collection of nematode samples is important because nematode populations fluctuate throughout the year. Nematodes may be undetectable during the winter and early spring but increase to very high levels before harvest; following harvest, population levels may decline precipitously. Sampling when population densities are high decreases the risk of failing to detect a damaging species. The best time to collect samples is when living roots are present and nematode populations are high. For most crops, this is generally near harvest.

The optimum time to take samples for nematode assay from various Georgia crops are given below:

CROP	WHEN TO SAMPLE	COMMON NEMATODES
Cotton	September, October, November	Root-Knot, Columbia Lance, Reniform
Fruit Orchards (except peaches)	September, October	Root-Knot
Peaches	September, October (for root-knot) February, March, April (for ring)	Root-Knot, Ring
Peanuts	September, October	Root-Knot
Soybeans	September (group IV) October (groups V, VI) November (group VII)	Root-Knot, Columbia Lance, Reniform, Soybean Cyst
Tobacco	July	Root-Knot
Turfgrass		Root-Knot, Lance, Sting, Ring
warm season	June, July, August	
cool season	September, October, April	
Vegetables	August, September	Root-Knot

From roughly December through March, most Georgia soils are too cold to support active root growth of warm-season crops and nematode populations exist primarily as eggs. Unfortunately, typical laboratory assays do not detect nematode eggs, so samples collected in the winter frequently fail to detect nematodes when there are actually many nematode eggs present. Failure to detect a species does not necessarily mean that it is not present because the species may be present at low levels that the random sample missed or it may be present only as eggs, which the assay cannot detect. Because of these limitations, samples should not be collected during the winter. Soil moisture should be about right for good seed germination when nematode samples are taken.

- III. HOW TO SAMPLE:** It is very important that the soil sample be truly representative of the area sampled. The only way to ensure this is to collect the sample from many spots around the field rather than from only one or two spots. Even if a small problem area is being sampled, soil should still be collected from multiple spots within the area being sampled. Ideally, one soil sample should be taken for every four to five acres, but practically, one sample may have to represent a much larger area of a field. The sample may represent a section that has homogeneous soil type and conditions and is farmed uniformly. The shape of a field may influence the number of acres that a sample represents. If a very large area is sampled, high-population areas will be diluted by low-population areas so that areas with nematode problems will be more difficult to identify.

Take 20-30 soil cores from random locations throughout the field. One sample should not represent more than 20 acres. If a problem area is being sampled, collect soil from the margin of the affected area. Collect soil to a depth of 8 inches (20 cm) in the root zone of living plants. Sampling depth may be different with certain crops, such as turf. Thoroughly mix the collected soil and put about 1 pint of soil into a plastic bag. **Do not take samples from extremely dry soil. DO NOT ALLOW SAMPLES TO GET HOT OR DRY!** Storing samples in an insulated cooler protects them well. Allowing samples to sit in direct sunlight or in a hot vehicle for even a short time can kill the nematodes in the sample. Nematodes must be alive for the extraction procedure to work. Killing the nematodes in the sample may result in failure to detect nematodes when they are actually present. Send samples early in the week so that they do not spend the weekend in transit.

- IV. SHIPPING SOIL SAMPLES FOR NEMATODE ASSAY:** All samples for nematode assay must be submitted through your local county Extension office. Your county Extension office will send the samples to the Extension Nematology Laboratory, 2350 College Station Road, The University of Georgia, Athens, GA 30602. The results of the assay will be returned to you through your county Extension office. Samples for problem diagnostics submitted through the county Extension office of sample origin will be analyzed at no charge. Samples for purposes other than problem diagnostics submitted through the county Extension office of sample origin will be charged \$12 per sample. All other samples, including samples submitted from out of state NOT submitted through the county Extension office of sample origin, will be charged \$25 per sample.

V. SUMMARY OF HOW TO COLLECT AND SUBMIT A SOIL SAMPLE FOR A NEMATODE ASSAY

1. Collect a soil sample for nematode assay.
 - a. Take 20-30 soil cores from random locations throughout a field. If a problem area is being sampled, collect soil from the margin of the affected area.
 - b. Collect soil to a depth of 8 inches (20 cm) in the root zone of living plants. Sampling depth may be different with certain crops, such as turf.
 - c. Thoroughly mix the collected soil and put about 1 pint of soil into a plastic bag. Seal tightly.
 - d. Keep samples cool. Do not allow samples to dry out.
2. Fill out a "NEMATODE ASSAY FORM" for each sample. Supply all information requested. You **MUST** list present, past, and future crop to assist in identifying nematode problems and making management recommendations. Also list variety grown. Variety information is critical for soybeans and tobacco.
3. Carefully label plastic bags on the outside with a permanent marker.
4. Your county Extension office will send the sample to the Extension Nematology Laboratory in Athens. The results of the assay and recommendations will be returned to you through your county Extension office. Keep a record of which nematodes are found in which fields.

WEEDS

Tim R. Murphy, Extension Agronomist-Weed Science

Correct identification may be required to ensure the proper choice of control methods. Weed specimens may be identified for you by this procedure:

1. Collect a representative specimen, preferably with flowers and fruit, but definitely with leaves, stem and roots.
2. Place specimen between sheets of newspaper and mail in a padded envelope. **DO NOT** send specimens wrapped in wet paper towels and sealed in plastic bags. (Aquatic plants may be shipped in moist paper towels in a zip lock bag.)
3. Send a letter with at least this information:
 - a. Associated desirable plants, type of turfgrass or crop.
 - b. Degree of infestation and size of the weed.
 - c. If control suggestions are required.

SHIPPING WEED SPECIMENS FOR IDENTIFICATION

Send the specimen to the weed scientist who has responsibilities for weed control on the site or crop where the weed was found:

Dr. Tim R. Murphy
Crop and Soil Sciences
1109 Experiment Street
UGA-Griffin Campus
Griffin, GA 30223-1797

Responsibilities
Forages

Dr. Stanley Culpepper
Horticulture Building
P.O. Box 748
Tifton, GA 31793

Responsibilities
Cotton
Vegetables
Small Grains

Dr. Eric Prostko
Horticulture Building
P.O. Box 748
Tifton, GA 31793

Responsibilities
Corn
Sorghum
Peanuts
Soybeans
Canola

Mr. Wayne Mitchem
Research & Educ. Center
Fanning Bridge Road
Fletcher, NC 28732

Responsibilities
Apples
Peaches
Grapes
Muscadines

Dr. Mark Czarnota
Horticulture
1109 Experiment Street
UGA-Griffin Campus
Griffin, GA 30223-1797

Responsibilities
Ornamentals
Christmas Trees

Lisa Ames
UGA Homeowner Insect and Weed
Diagnostic Laboratory
210 Cowart Bldg. UGA-Griffin Campus
1109 Experiment Street
Griffin, GA 30223-1797

Responsibilities
Home Gardens
Home Lawns

Dr. Patrick McCullough
Crop and Soil Sciences
1109 Experiment Street
UGA-Griffin Campus
Griffin, GA 30223-1797

Responsibilities
Turfgrasses (commercial)
Noncropland

Dr. Gary Burtle
Plant Science Building
P.O. Box 748
Tifton, GA 31793

Responsibilities
Aquatic Weeds
Fish

FISH

Updated by Gary J. Burtle

GUIDELINES FOR SUBMISSION FOR DIAGNOSTIC SERVICE

In the case of fish kills suspected to be the result of diseases, parasites, insecticides, and other chemicals, fish specimens may have to be examined to confirm the problem. It is very important the fish be collected and shipped so they arrive at the laboratory in a usable condition.

A. Diseases and Parasites:

The Diagnostic Assistance Laboratories located at the College of Veterinary Medicine, Athens and Tifton, as well as the Extension Fisheries Specialist, now offer services in the area of fish problems. Assistance is available to veterinarians, county Extension agents, fish farmers, or other interested individuals. Specimens of fish should be submitted in the following manner:

1. Live fish showing symptoms of disease are always preferred for examination. Small live fish should be placed in a 5 gallon plastic bag half full of water and topped off with air or preferably oxygen if available. Seal the top of the bag. This is the most desirable sample.
2. Dead fish should be packed in plastic bags without water and sealed. These bags should be placed in a larger container with an ice pack for shipment. **Do Not Freeze!!** Fish must be freshly dead for sample to be useable.
3. Preserved fish or fish organs should be placed in 10% formalin (10 parts formalin + 90 parts water) in a plastic container.
4. Call the appropriate laboratory before the shipment is dispatched to ensure personnel will be available to take care of the specimens when they arrive.

Commercial transportation, bus, UPS, mail, etc., are usually unsatisfactory as methods of sending live or fresh fish specimens to the laboratories. Direct courier is the only way to ensure specimens will arrive at the laboratory in a usable condition. The results from the laboratory are only as good as the specimen submitted.

Regardless of what method is chosen for submission of fish samples, it is mandatory that a detailed written history be submitted including such facts as: name and address, water temperature, amount of water in tank or pond, number of fish and the species, feeding schedule and type of feed, any antibiotic or chemical therapy, changes in color or swimming ability of fish, duration of illness, and number of fish lost. In all aquaculture cases, report dissolved oxygen, nitrite, total ammonia, pH, alkalinity and chloride if possible. A sample of pond water should be sent with the fish.

Samples should be transported to the laboratory by the fastest means possible. A visit to the farm by specialists may be necessary for better understanding of a fish mortality, but it would be undertaken only after laboratory examination of a fish from a problem water source.

The North Georgia Diagnostic Assistance Laboratory is located at the College of Veterinary Medicine, Room 227. Laboratory hours are 8:00 a.m. to 5:00 p.m., Monday through Friday. The contact telephone number is 706-542-5568, Dr. Doris Miller. For immediate service, an appointment is needed.

The South Georgia Diagnostic Assistance Laboratory is located at the intersection of I-75 and Brighton Road, Tifton, GA. The contact telephone number is 229-386-3340, Dr. Alan Liggett or Dr. Gary Burtle 229-386-3364. For immediate service an appointment is needed. Utilize the Distance Diagnostic Digital Imaging System when possible.

B. Insecticides and Other Chemicals:

1. Live fish should be collected, wrapped in tin foil, and frozen before shipping.
2. Frozen fish should be packed in plastic bags without water and sealed. This bag should be placed in a large container (preferably a styrofoam cooler) and surrounded with ice (preferably dry ice) for shipment.
3. Call the Extension Fisheries Specialist to ensure personnel will be available to take care of the specimens when they arrive.
4. Commercial transportation, such as a bus or UPS is satisfactory; that is, as long as the transit time is short enough to ensure the fish will arrive still frozen. Do not mail the fish. Direct courier is the best way to ensure specimens will arrive at the laboratory in a usable condition.
5. A minimum of 30 grams (1 ounce) of fish must be submitted for analysis.

FISH HABITAT: WATER SAMPLING PROCEDURES

Containers:

1. Plastic quart bottle for all analyses except pesticides and heavy metals. (Small plastic 120 ml bottle for Tifton, Alkalinity).
2. Glass quart bottle with tin foil lined lids for pesticides and heavy metals analyses. Two samples should be submitted: one each for pesticides and heavy metals.

Method of Sampling:

1. Samples should be collected 6 inches below the water surface with clean containers.
2. Water should not be sampled near any inflows.
3. Care should be taken not to contaminate samples with mud, plant or insect material. Contact the Extension Fisheries Specialist before submitting a water sample for analysis.

VERTEBRATES

Mike Mengak, Wildlife Specialist

(Hand carry or mail specimen to Mike Mengak, Wildlife Specialist, Warnell School of Forestry and Natural Resources, The University of Georgia, Athens, Georgia 30602 - Telephone Number (706) 583-8096, FAX Number (706) 542-8356, Email mmengak@uga.edu).

LIVE SPECIMENS

Live organisms may be held for several days pending identification and later released. The key is to provide air, moisture, water, and sometimes food. Keep from direct sun, excessive heat and freezing temperatures. All wildlife can carry potentially harmful diseases and care should be taken when handling live animals. Most, including snakes, are protected by law. A permit from the Georgia Department of Natural Resources is required before collecting nearly all specimens.

Snakes and Lizards

Place in bag of tight weave cloth or container with tight fitting perforated lid. Include a handful of damp leaves or moss. Keep at room temperature out of the sun. Specimens can do without food for a week or more. Place snakes in container with water for a few hours every few days. Spray water in container with lizards; they will lap water drops.

Frogs, Toads, and Salamanders

Place in cloth bag with plenty of damp leaves or moss. Sprinkle bag with water as necessary to keep moist.

Aquatic Salamanders and Tadpoles

Care for as live fish.

DEAD SPECIMENS

Rodents and Other Small Vertebrates

Small mammals taken from traps, or other dead vertebrates such as reptiles and amphibians, can be preserved in 10% formalin solution (one part formalin : nine parts water). Seventy to eighty percent (70-80%) alcohol will also do as a preservative. Inject body cavity or pierce in several places. Place in plastic bottle with tight-fitting lid. Pack jar in mailing tube or well-made cardboard box. Contact package service or postal service prior to shipping specimens.

Dry animal parts such as skulls or pieces of skin can be placed in mailing tubes. Pack with crumpled paper. Accurate identification is easier with whole specimens in good condition. Skulls (cleaned and free of insects or tissue) are best for identification of mammals.

DIGITAL PHOTOS

Often digital photography will provide enough information for an identification. You can photograph many kinds of small animals - alive and dead. You can easily photograph harmless snakes, frogs, turtles, lizards, etc. Use a setting that will show pattern. **Use adequate light and neutral background.** Take several pictures from various angles. For snakes and lizards, photograph head, face, belly and back showing all lines or patterns. Mail or email the photo to the Wildlife Specialist.

PESTICIDES, FUMIGANTS, TOXICANTS

Use of poisons may be restricted to licensed pesticide applicators only. Always consult the label of a current product for expiration data and legal restrictions on use and application. Always conform to pesticide labels but use caution if working with older formulations or products - the EPA registration may have expired.

Current information on Pests and Pesticide products can be found by searching EPA websites, state registration websites, other online sources or contacting your local county agent.

Additional information on pesticide use can be found at www.kellysolutions.com/ga/searchbypest.asp