2026

Southeast Regional Strawberry

INTEGRATED PEST MANAGEMENT GUIDE FOCUSED ON PLASTICULTURE PRODUCTION

UNIVERSITY OF GEORGIA
EXTENSION

2026 Southeast Regional Strawberry Integrated Pest Management Guide Focused on Plasticulture Production

A product of the Southern Region Small Fruit Consortium

Commodity Editor

Rebecca A. Melanson, Mississippi State University

Senior Editors

Phil Brannen, University of Georgia
Bill Cline, North Carolina State University

Section Editors

Pathology

Guido Schnabel, Clemson University
Rebecca A. Melanson, Mississippi State University
Phil Brannen, University of Georgia
Mary Helen Ferguson, Louisiana State University
Johan Desaeger, University of Florida
Bill Cline, North Carolina State University
Ioannis Tzanetakis, University of Arkansas
Raj Singh, Louisiana State University
Nicole Gauthier, University of Kentucky
Caleb Bollenbacher, North Carolina State University
Jensen Hayter, University of Tennessee
Mustafa Jibrin, Oklahoma State University

Vertebrate Management

David Lockwood, University of Tennessee

Entomology

Aaron Cato, University of Arkansas
Doug Pfeiffer, Virginia Tech
Lorena Lopez, North Carolina State University
Jermaine Perier, Mississippi State University
Tom Bilbo, Clemson University

Weed Science

Hannah Wright-Smith, University of Tennessee

Horticulture

Jayesh Samtani, Virginia Tech
Edgar Vinson, Auburn University
Eric Stafne, Mississippi State University

Table of Contents

Southeastern Region University Small Fruits IPM Contacts

Auburn University
Extension website:
www.aces.edu/
Entomology:
Paulo Cremonez
Horticulture:
Elina Coneva, Edgar Vinson
Plant Pathology:
Ed Sikora

University of Arkansas
Extension website:
uaex.uada.edu/
Food Science (Post Harvest):
Renee Threlfall
Horticulture:
Amanda McWhirt
Entomology:
Aaron Cato
Plant Pathology:
Aaron Cato, Ioannis Tzanetakis (virology)
Weed Science:
Matt Bertucci

Clemson University
Extension website:
clemson.edu/extension/
Entomology:
Tom Bilbo (strawberry), Brett Blauuw

Horticulture:
Juan Carlos Melgar, Melissa Muñoz
Plant Pathology:
Elizabeth Cieniewicz (virology), Guido Schnabel, Lindsey Thiessen
Weed Science:
Wayne Mitchem

University of Florida
Extension website:
sfyl.ifas.ufl.edu/
Entomology:
Oscar Liburd
Horticulture:
Jeff Williamson
Plant Pathology:
Johan Desaeger (nematology), Phil Harmon, Natalia Peres (strawberry)
Weed Science:
Nathan Boyd

University of Georgia
Extension website:
extension.uga.edu/
Entomology:
Brett Blauuw, Glen Rains, Ash Sial
Horticulture:
Zilfina Rubio Ames, Sarah Lowder
Plant Pathology:
Phil Brannen, Jonathan Oliver
Weed Science:
Mark Czarnota, Wayne Mitchem

University of Kentucky
Extension website:
extension.ca.uky.edu/
Entomology:
Ric Bessin
Horticulture:
Brent Arnoldussen, Daniel Becker, Patsy Wilson (grapes), Shawn Wright
Plant Pathology:
Nicole Gauthier
Weed Science:
Shawn Wright

Louisiana State University
Extension website:
lsuagcenter.com/
Horticulture:
Michael Polozola
Plant Pathology:
Mary Helen Ferguson, Raghuwinder (Raj) Singh

Mississippi State University
Extension website:
extension.msstate.edu/
Entomology:
Jermaine Perier
Horticulture:
Eric Stafne
Plant Pathology:
Rebecca A. Melanson
Weed Science:
John Byrd

North Carolina State University
Extension website:
www.ces.ncsu.edu/
Entomology:
Lorena Lopez
Horticulture:
Mark Hoffmann, Alexa McDaniel (viticulture)
IPM:
Ryan Adams
Plant Pathology:
Caleb Bollenbacher, Bill Cline, Sara Villani
Weed Science:
Katie Jennings, Wayne Mitchem

University of Tennessee
Extension website:
utextension.tennessee.edu/
Horticulture:
David Lockwood, Annie Vogel
Plant Pathology:
Jensen Hayter
Weed Science:
Hannah Wright-Smith

Virginia Tech
Extension website:
ext.vt.edu/
Entomology:
Doug Pfeiffer
Horticulture:
Drew Harner (viticulture), Jayesh Samtani
Plant Pathology:
Mizuho Nita (grapes), Yuan Zeng
Weed Science:
Jeff Derr

Southeastern Region University Diagnostic Laboratories

Additional university diagnostic services may be available. Visit the Southern Plant Diagnostic Network (SPDN) website (www.npdn.org/spdn) for a directory of SPDN diagnostic laboratories. Private laboratories may also offer diagnostic services. Contact each laboratory or your local county Extension agent to determine which services are offered, the fee structure, and sample submission instructions.

Auburn University

Auburn Plant Diagnostic Lab (Auburn, AL):
https://www.aces.edu/go/PlantLab

University of Arkansas

Arkansas Nematode Diagnostic Laboratory (Hope, AR):
https://www.uaex.uada.edu/farm-ranch/pest-management/plant-disease/nematodes/diagnostic-lab.aspx

Plant Health Clinic (Fayetteville, AR):
https://www.uaex.uada.edu/yard-garden/plant-health-clinic/

Clemson University

Plant and Pest Diagnostic Clinic (Pendleton, SC):
https://www.clemson.edu/public/regulatory/plant-problem/

Molecular Pathogen and Pest Detection Lab (Pendleton, SC):
https://www.clemson.edu/public/regulatory/plant-problem/mppd.html

University of Florida

UF/IFAS Plant Diagnostic Center (Gainesville, FL):
https://plantpath.ifas.ufl.edu/extension/plant-diagnostic-center/

University of Georgia

Plant Molecular Diagnostic Lab (Tifton, GA): https://site.caes.uga.edu/mdl/

Plant Disease and Nematode Clinics (Athens, GA, and Tifton, GA):
https://plantpath.caes.uga.edu/extension/plant-disease-clinics.html

University of Kentucky

Plant Disease Diagnostic Laboratory (Lexington, KY):
https://plantpathology.ca.uky.edu/extension/diagnostic-laboratories

Louisiana State University

Plant Diagnostic Center (Baton Rouge, LA):
https://www.lsuagcenter.com/portals/our_offices/departments/plant-pathology-crop-physiology/plant_disease_clinic

Mississippi State University

Extension Plant Diagnostic Lab (Starkville, MS):
https://extension.msstate.edu/lab

North Carolina State University

Plant Disease and Insect Clinic (Raleigh, NC): https://pdic.ces.ncsu.edu/

Oklahoma State University

Plant Disease and Insect Diagnostic Lab (Stillwater, OK):
https://agriculture.okstate.edu/departments-programs/entomol-plant-path/research-and-extension/plant-disease-insect-diag-lab/

University of Tennessee

Soil, Plant and Pest Center (Nashville, TN):
https://soillab.tennessee.edu/plant-pests/

Virginia Tech

Plant Diagnostic Clinic (Blacksburg, VA):
https://spes.vt.edu/affiliated/plant-disease-clinic.html

Pesticide Emergencies

1-800-222-1222

This number automatically connects you with a local Poison Control Center from anywhere in the United States.

Symptoms of Pesticide Exposure

- **Tightening of the chest, mental confusion, blurred vision, rapid pulse, intense thirst, vomiting, convulsions, and unconsciousness are always serious symptoms! Dial 911!**
- **Pesticides with 'DANGER' or 'DANGER/POISON' on the product label can cause severe injuries or death very quickly, even with small exposures. Take immediate action!**
  Other symptoms of pesticide poisoning: headache, fatigue, weakness, restlessness, nervousness, profuse sweating, tearing and drooling, nausea, diarrhea, or irritation of the skin/ eyes/nose/throat. Consult the product Material Safety Data Sheet (MSDS or SDS) for symptoms associated with a particular pesticide.

Pesticide on Skin

- WASH, WASH, WASH! Immediately wash pesticide from skin as thoroughly as possible with any available water that does not contain pesticides.
- Quickly remove protective clothing and any contaminated clothing.
- *Rewash* contaminated skin with soap and water as soon as possible.
- If the victim experiences *any* symptom(s) of poisoning, get medical assistance immediately. *Take the pesticide label with you*, but do not contaminate vehicles or expose others if you must take the container with you.

Pesticide in Eyes

- Rinse eye(s) gently with *clean* water for *at least* 15 minutes. Be careful of water temperature.
- If eye remains irritated or vision is blurry after rinsing, get medical attention right away! *Take the pesticide label with you*, but do not contaminate vehicles or expose others if you must take the container with you.

Pesticide in Mouth or Swallowed

- Provide / drink large amounts of water or milk to drink. *Do not give liquids to a person who is unconscious or convulsing!*
- Consult the label **BEFORE** vomiting is induced – the label may advise against inducing vomiting. Do not induce vomiting with emulsifiable concentrate (E, EC) formulations.
- *Do not induce vomiting if a person is unconscious or is convulsing!*
- Seek medical attention. *Take the pesticide label with you*, but do not contaminate vehicles or expose others if you must take the container with you.
- If the pesticide was not swallowed, *rinse mouth thoroughly with clean water*. If mouth is burned or irritated, consult a physician.

Pesticide Emergencies (Continued)

Pesticide Inhaled

- Move victim to fresh air immediately!
- Warn others in the area of the danger.
- Loosen tight clothing.
- Administer artificial respiration if necessary, but try to determine if the person also may have swallowed any pesticide. Avoid any pesticide or vomit that may be around the victim's mouth.
- Seek medical attention. *Take the pesticide label with you*, but do not contaminate vehicles or expose others if you must take the container with you.

Heat Stress

- Move the victim to a cooler area, remove protective clothing, and pour cool water over the person.
- Give cool liquids to drink. *Do not give liquids to a person who is unconscious or convulsing!*
- Pesticide poisoning may mimic heat illness! Get medical attention if the person is unconscious or if the person is not fully recovered within 15 minutes of cooling down and drinking liquids.

Signal Words

- The pesticide signal word will appear on the pesticide label. It provides information about the acute risks of the pesticide to people.
  - **DANGER/POISON**: *Highly toxic* - less than a teaspoon can kill an adult.
  - **DANGER**: *Highly toxic* - pesticide can cause severe eye and/or skin injury.
  - **WARNING**: *Moderately toxic* - two tablespoons or less can kill an adult.
  - **CAUTION**: *Slightly toxic* - an ounce or more is required to kill an adult.

Understand that the signal word does *not* provide information about long term pesticide exposure risks (e.g., cancer) or allergic effects. Minimize your exposure to *all* pesticides. The signal word does *not* indicate environmental toxicity or other environmental effects.

Pesticide Spills and Environmental Emergencies

Spills on Public Roads (Usually call the state police/state highway patrol. In many cases, you can call 911.)

State	Agency	Phone Number
Alabama	Alabama Highway Patrol Alabama Department of Environmental Management Alabama Emergency Management Agency	Cell: call *HP (334) 271-7700 (205) 280-2200
Arkansas	Arkansas Department of Emergency Management	(501) 683-6705
Georgia	Georgia State Patrol	Cell: call *GSP *or* 911
Louisiana	LDAF Emergency Hotline Louisiana State Police Hazardous Material Hotline	1-855-452-5323 (225) 925-6595 or 1-877-925-6595
Mississippi	Mississippi Emergency Management Agency (MEMA)	1-800-222-6362
North Carolina	Regional Response Team (RRT) For spills not on public roads, contact the Pesticide Section of NCDA&CS	911 *or* your RRT (919) 733-3556 *or* (800) 662-7956 during non-business hours
South Carolina	South Carolina Highway Patrol South Carolina DHEC Emergency Response Section	Cell: call *HP 1-888-481-0125
Tennessee	Tennessee Emergency Management Agency (TEMA) State Emergency Operations Center	1-800-262-3300
Virginia	Virginia Emergency Operations Center	1-804-267-7600

*****For assistance with **on-farm spills**, contact your local state Department of Agriculture.

Environmental Emergencies (contamination of waterways, fish kills, bird kills, etc.)

State	Agency	Phone Number
Alabama	Alabama Department of Environmental Management Alabama Emergency Management Agency Alabama Department of Conservation and Natural Resources	(334) 271-7700 (205) 280-2200 (334) 242-3469
Arkansas	Arkansas Department of Emergency Management	(501) 683-6705
Georgia	Georgia Department of Natural Resources Response Team	1-800-241-4113
Louisiana	LDAF Emergency Hotline	1-855-452-5323
Mississippi	Mississippi Emergency Management Agency	1-800-222-6362
North Carolina	North Carolina Division of Water Quality	1-800-858-0368
South Carolina	South Carolina DHEC	1-888-481-0125
Tennessee	Tennessee Wildlife Resources Agency	Region 1, West Tennessee: 1-800-372-3928 Region 2, Middle Tennessee: 1-800-624-7406 Region 3, Cumberland Plateau: 1-800-262-6704 Region 4, East Tennessee: 1-800-332-0900
Virginia	Virginia Emergency Operations Center	1-804-267-7600

Pesticide Liability and Stewardship

The **Pesticide Environmental Stewardship** website is located at http://pesticidestewardship.org. Information on proper pesticide use and handling, calibration of equipment, reading pesticide labels, disposal, handling spills, and other topics are presented.

Pesticide applicators, supervisors, and business owners may all face severe criminal and/or civil penalties if pesticides are misused – knowingly or accidentally.

***The Pesticide Label*:** Federal and state laws require pesticide applicators to follow the directions on the pesticide label exactly. Do not exceed maximum label rates, apply a pesticide more frequently than stated on the label, or apply a pesticide to a site that is not indicated on the label. Labels change; review yours regularly.

***Compliance with the Endangered Species Protection Program*:** Beginning in 2024, additional pesticide label instructions, intended to protect threatened and endangered species and their designated critical habitat, may be required for certain pesticides, when applied in a pesticide use limitation area (PULA). If a pesticide label directs product users to the Bulletins Live! Two system, users are **REQUIRED** to obtain an Endangered Species Protection Bulletin **prior to product application**. Endangered Species Protection Bulletins are specific for an intended application area, pesticide product, and application month and may provide additional limitations or restrictions for product use. Users must know the site of product application (location), application month, and EPA Registration Number of the product in order to obtain a bulletin. Bulletins may be accessed up to 6 months before product application and can be saved to a computer or printed. Bulletins are enforceable, if referenced on a pesticide label, by Federal Insecticide, Fungicide and Rodenticide Act (FIFRA). For additional information or updates on these new requirements, visit the EPA Endangered Species Protection Bulletin webpage, and contact your local county Extension agent or specialist.

***Restricted Use Pesticides (RUP)*:** These pesticides are clearly labeled "Restricted Use Pesticide" in a box at the top of the front label. Applicators purchasing, applying, or supervising the application of a RUP must be certified or licensed through their state pesticide regulatory agency. Some states have mandatory licensing for certain pesticide use categories whether or not RUPs are applied.

***Personal Protective Equipment (PPE)*:** Anyone handling or applying pesticides must wear the PPE stated on the pesticide label. The EPA Worker Protection Standard (WPS) requires applicators to wear the label required PPE and agricultural employers to supply the label PPE and ensure that the PPE is worn correctly by applicator employees. Do not wear PPE items longer than it has been designed to protect you. Clean, maintain, and properly store PPE. Do not store PPE with pesticides.

***Reentry Interval (REI)*:** The period of time immediately following the application of a pesticide during which unprotected workers should not enter a field.

***Pre-Harvest Interval (PHI)*:** The time between the last pesticide application and harvest of the treated crops.

Pesticide Liability and Stewardship (Continued)

***EPA Worker Protection Standard (WPS)*:** WPS changes continue to be implemented. Growers should consult the EPA website (https://www.epa.gov/pesticide-worker-safety/agricultural-worker-protection-standard-wps) or their local extension service for the most up to date information. Growers who employ one or more *non*-family members must comply with the WPS. This standard requires agricultural employers to protect applicator employees and agricultural worker employees from pesticide exposure in the workplace by 1) providing specified pesticide safety training, 2) providing specific information about pesticide applications made on the agricultural operation, 3) providing and ensuring that applicators wear clean and properly maintained label required PPE, 4) providing decontamination facilities for potential pesticide and pesticide residue exposures, and 5) providing timely access to medical assistance in the event of a suspected pesticide exposure. These protections apply to both restricted use pesticides *and* general use pesticides used in agricultural plant production.

***Enclosed Structures*:** Pesticides labeled for field applications may not be allowed for use in enclosed structures or may have additional restrictions. Definitions of enclosed structures differ between states but may include greenhouses and high tunnels. Consult your local Extension service or state Department of Agriculture for guidance and appropriate recommendations. WPS for enclosed structures may also differ than those for field-grown plants.

***Pesticide Recordkeeping*:** You must keep records of all RUP applications for at least two years under the Federal (USDA) Pesticide Recordkeeping Requirement if your state does not have its own pesticide recordkeeping requirements. Some states require records be kept for longer than the federal requirement. Maintaining records of all pesticide applications, not just RUP applications, indefinitely, cannot only help troubleshoot application problems, but also allows you to reference successful applications and can help protect against future liability. Consult your local Extension service for details.

***Emergency Preparedness*: Be prepared for emergencies.** Store pesticides and clean empty containers securely. Develop and provide written plans and training to prepare your employees and family members for pesticide fires, spills, and other emergencies. Assign responsibilities to be carried out in the event of pesticide emergencies. Keep copies of the pesticide labels and MSDSs away from the area where pesticides are stored. Provide copies of product MSDSs to your community first responders. Consult your local Extension Service and insurance company for assistance.

***Pesticide Disposal*: Properly dispose of clean empty pesticide containers and unwanted pesticides as soon as possible**. Containers can often be recycled in a pesticide container recycling program. Unwanted pesticides may pose a risk of human exposure and environmental harm if kept for long periods of time. Consult your local Extension service for assistance.

General Pesticide Information

Mode of Action (MOA): Pesticides affect target pests in a variety of ways, and the way a pesticide kills the target organism is called the ***mode of action*** **(MOA)**. Although pesticides have different names and may have different active ingredients, they may have the same MOA. Over time, pests can become resistant to a pesticide, and typically this resistance applies to all pesticides with the same MOA. When rotating pesticides, it is important to select pesticides with different MOAs.

The **Fungicide Resistance Action Committee** (FRAC), **Insecticide Resistance Action Committee** (IRAC) and IRAC Nematode Working Group, and the **Weed Science Society of America** (WSSA) have organized crop protection materials into groups with shared MOAs and given them specific codes, which appear on pesticide labels. Some MOAs may be unknown and given a code with a **U**. *When selecting pesticides, avoid successive applications of materials in the same MOA group to minimize potential resistance development*. MOA categories are listed in this guide to aid in the development of resistance management programs. More information about this topic can be found at www.frac.info, www.irac-online.org, and www.wssa.net.

Organic Materials Review Institute (OMRI; www.omri.org): Products that are listed by OMRI are commonly accepted for use in organically certified production systems. Always consult your organic certifier prior to use. **OMRI-**listed materials are indicated in the comments section.

Generics: Many pesticide active ingredients are available in generic formulations. For brevity, these formulations are not generally listed. Listed trade names are included to aid in identifying products and are not intended to promote the use of these products or to discourage the use of generic products. Generic products generally work similarly to their brand name counterparts, but formulation changes can impact efficacy and plant response. As with any new chemical, read and follow all label instructions. Chemical names are subject to change; please check the active ingredient for all materials.

The **Pesticide Environmental Stewardship** website is located at http://pesticidestewardship.org. Information on proper pesticide use and handling, calibration of equipment, reading pesticide labels, disposal, handling spills, and other topics are presented.

Resistance Management: Insects, weeds, and disease-causing organisms are all capable of developing resistance to pesticides. To minimize the likelihood of resistance development against your material of choice:

1. Only use pesticides when necessary. When the damage caused by the pest you are controlling is greater than the cost of the pesticide and no other, effective options are available.
2. Use the appropriate material for the pest.
3. Use the recommended rate of the material. Do not use a lower rate than listed on the label.
4. If more than one treatment is needed when the same pest is present, rotate the pesticide MOA between treatments.

General Pesticide Information (Continued)

State Registrations: Keep in mind that this publication is a regional guide. Every product listed may not be available or registered for use in every state. Before purchasing and applying a product, verify that that product is registered for use in your state. This may be done by visiting one of several online databases (examples provided below) that provide information on the state registration status of various products, by visiting product manufacturer websites, or by contacting your Extension agent or an appropriate state Extension specialist.

Database	Web Address
TELUS Agronomy (formerly Agrian Label Database)	https://www.agrian.com/labelcenter/results.cfm
Telus Label Database (formerly Crop Data Management Systems)	https://www.telus.com/agcg/en-us
EPA Pesticide Product and Label System	https://ordspub.epa.gov/ords/pesticides/f?p=PPLS:1
Greenbook Data Solutions	https://www.greenbook.net/
Kelly Registration Systems[1]	http://www.kellysolutions.com
National Pesticide Information Retrieval System[2]	https://www.npirs.org/state/https://www.npirs.org/state/

[1]Available for AR, FL, GA, LA, MS, NC, OK, SC, TX, and VA in the southeastern U.S.
[2]Available for AL, AR, FL, KY, LA, NC, TX, and VA in the southeastern U.S.

CAUTION: Specific rates, application methods, and sometimes target pests vary on product labels containing the same active ingredient and are subject to change at any time. Always refer to and read the pesticide label before making any application!!

Formulation Abbreviations: Abbreviations commonly used in product formulations that appear in the tables include DF = dry flowable; EC = emulsifiable concentrate; EW = emulsion, oil in water; F = flowable; L = liquid; SC = spray concentrate; SL = soluble concentrate; EG, WG, or WDG = water dispersible granule; W or WP = wettable powder; and WSB = water soluble bag.

Other Abbreviations: Another abbreviation that may appear in product names is XLR = extra long residual.

Efficacy Ratings: The efficacy or importance of a management option is indicated by E = excellent, VG = very good, G = good, F = fair, P = poor, NC = no control, and ND = no data. These ratings are benchmarks; actual performance will vary. A superscript 'R' (^{R}) next to the efficacy rating indicates that the product may not be effective if the pathogen is resistant to the fungicide.

Pollinator Protection

Before making insecticide applications, monitor insect populations to determine if treatment is needed. If pesticide (fungicide, insecticide, or miticide/acaricide) application is necessary:

1. Use selective pesticides to reduce risk to pollinators and other non-target beneficial insects. Visit the Commonly Used Pesticides Grouped According to Their Relative Hazards to Honey Bees table in the Georgia Pest Management Handbook for specific pesticide hazard levels.
2. Read and follow all pesticide label directions and precautions. The label is the Law! EPA now requires the addition of a "Protection of Pollinators" advisory box on certain pesticide labels. Look for the bee hazard icon in the Directions for Use and within crop specific sections for instructions to protect bees and other insect pollinators.
3. Minimize infield exposure of bees to pesticides by avoiding applications when bees are actively foraging in the crops. Bee flower visitation rate is highest in early morning. Apply pesticides in the late afternoon or early evening to allow for maximum residue degradation before bees return the next morning. Bee foraging activity is also dependent upon time of year (temperature) and stage of crop growth. The greatest risk of bee exposure is during bloom. Consider mowing ground cover if plants are flowering prior to pesticide application.
4. Follow label directions to minimize off target movement of pesticides. Do not make pesticide applications when the wind is blowing towards beehives or off-site pollinator habitats.

Considerations for Sprayer Equipment for Pesticides

In addition to appropriate selection of pesticides for product efficacy and resistance management, proper application of products for disease, insect, and weed management requires appropriate selection, preparation, and maintenance of spray equipment for adequate spray coverage and canopy penetration. With regard to the spray equipment utilized, nozzle selection and sprayer calibration are extremely important considerations. Calibration factors include tractor speed and pumping system pressure, and all producers need to understand how these factors impact spray coverage and product efficacy for each targeted use pattern.

Again, using an appropriate nozzle for the intended use is critical. Numerous nozzles of various shapes, sizes, and output (gallons per minute, GPM) are available for purchase. Nozzle selection will determine droplet size, GPM of the spray leaving the nozzle, and spray pattern. Droplet size not only affects product coverage and distribution on surfaces but also influences the potential for drift. For example, larger droplets have a reduced potential for drift than smaller droplets. It is, therefore, important to apply herbicides with sufficient droplet size to minimize drift. Smaller droplets, in comparison to larger droplets, increase spray distribution on surfaces and increase the chance for contact with fungal spores. Use of a nozzle that provides smaller (finer) droplet size may be beneficial when applying fungicides.

Routine sprayer calibration is necessary to achieve and maintain optimal performance of spray equipment and to ensure the desired and precise output (gallons per acre, GPA) of the IPM products. Pressure losses in the pumping system can alter the exact GPM being applied. In addition, nozzles may wear over time, become plugged, break, or have a slightly different output than that listed in the catalog. It is best to calibrate spray equipment BEFORE the season begins; in-season calibration may also be needed, particularly if distribution differences, such as “skips,” or other problems are observed. Spray equipment should also be calibrated if nozzles are replaced or if adjustments to spray equipment, such as changes to sprayer pressure, are made.

Tractor speed should be set to allow for sufficient spray coverage of target plants/tissue. Moving too fast will minimize the amount of spray that is delivered to an area and may not allow for sufficient spray delivery to plants. Moving too slow may deliver an overabundance of spray to plants, essentially ‘wasting’ spray and increasing costs. Sprayer pressure may also need to be adjusted, as plants grow, to ensure delivery of spray into plant canopies. Early-season applications will likely require less gallons of spray per acre than late-season applications, as the canopy increases in density and shoots grow.

Always conduct trials with water-sensitive cards scattered throughout the plant canopy to make sure you are getting the coverage you desire for the particular application, whether that be herbicides, insecticides, fungicides, etc. The time for determining whether the sprayer is effective is before applications are needed for insect, pathogen, or weed management.

Mobile and Online Tools

Southern Region Small Fruit Consortium (SRSFC) Website

A valuable repository (smallfruits.org) of resources for small fruit production and pest management. The SRSFC produces the e-newsletter Small Fruit News; sign up to receive future issues or search the archive for past articles. The SRSFC also provides funding for research and outreach activities; search the project list to learn the outcome of previously funded projects. Visit the website to learn more about the SRSFC and other available resources!

MyIPM App

A FREE smart phone app that contains strawberry pest and disease information (diagnostic key, photos, management guidelines, audio, and pesticide information). App content is updated by regional specialist and is available for download from the Apple App Store or the Google Play Store. Learn more at https://vimeo.com/486538727.

Bugwood Image Database

An online database (https://images.bugwood.org/) that includes high-quality images of many insects, diseases, and weeds.

Videos

Videos that discuss key strawberry diseases are available online:

Anthracnose: https://vimeo.com/509950986 (Spanish: https://vimeo.com/512642376)

Botrytis gray mold: https://vimeo.com/509908236 (Spanish: https://vimeo.com/509873058)

Photo Guides

Photo guides highlighting key arthropod pests and diseases of strawberry in the Southeast are available on the SRSFC website.

Southern Regional Strawberry Plasticulture Production Guide, 2nd edition (2024)

This publication is a comprehensive guide for strawberry production in the Southeast. It is available online (HTML and PDF) at https://content.ces.ncsu.edu/southern-regional-strawberry-plasticulture-production-guide. Updated by experts from across the Southeast, this guide highlights the strawberry and strawberry production; cultivars, marketing, and economics; and annual hill strawberry production and management.

Strawberry Diagnostic Key

A diagnostic tool available at https://diagnosis.ces.ncsu.edu/strawberry/ that includes information on insects, diseases, nutritional deficiencies, and physiological disorders.

Strawberry Advisory System

A weather-based decision support system available at https://ipm.ces.ncsu.edu/strawberry-fruit-infection-risk-tool/ that predicts fruit infection risk in North Carolina to help optimize spray timing for Botrytis gray mold and anthracnose fruit rots.

Insect Alert: Spotted Lanternfly

A new insect pest, spotted lanternfly (SLF, *Lycorma delicatula* (White)), has entered the Southeastern region. This insect is spreading through Virginia and, as of June 2025, has been found in isolated locations in the Southeast. SLF is in the planthopper family, and all stages are active jumpers. SLF has a broad host range. While grape is by far the most vulnerable crop, SLF feeds on more than 70 species of plants, including strawberries. Early SLF (nymphal stages) instars are black with white spots and are the stage most likely to be found on strawberry. Fourth instar nymphs are bright red with black and white markings. Adults have pinkish grey front wings with black spots. The pink cast is due to the bright red hind wings showing through the front wings. Evidence of SLF feeding includes the accumulation of honeydew on leaf surfaces, which supports the growth of the fungus that causes sooty mold. Economic significance of SLF is currently being examined. Nymphs can be controlled by many insecticides that are used for other early-season strawberry pests, e.g. bifenthrin, fenpropathrin, and carbaryl. In crops where adults are the main problem (late season), continued re-immigration is a significant problem. However, this is less likely to be the case if nymphs are found feeding on strawberry. Risk may be higher if plantings are near stands of tree-of-heaven, a key host tree.

Additional information on SLF can be found on the Virginia Tech Spotted Lanternfly webpage (https://www.virginiafruit.ento.vt.edu/SLF.html), in the article "Spotted lanterfly – Watch for a new invasive pest!" in the Spring 2020 issue of *Small Fruit News*, https://smallfruits.org/category/small-fruit-news/spring-2020/ , and in the Virginia Cooperative Extension publication "Spotted lanternfly, *Lycorma delicatula* (White) (Hemiptera: Fulgoridae)" (https://www.pubs.ext.vt.edu/ENTO/ENTO-180/ENTO-180.html). An updated SLF distribution map, maintained by Cornell University, is available at https://cals.cornell.edu/new-york-state-integrated-pest-management/outreach-education/whats-bugging-you/spotted-lanternfly/spotted-lanternfly-reported-distribution-map.

Photos: Spotted lanternfly early instar nymph (A), fourth instar nymph (B), and adults (C). Credit: Doug Pfeiffer, Virginia Tech.

Insect Alert: Chilli Thrips

Chilli thrips (*Scirtothrips dorsalis*) is an invasive and polyphagous pest with over 200 host plants, including vegetable, ornamental, and fruit crops. It is native to the Indian subcontinent and was intercepted approximately 89 times at several ports in the U.S. between 1984 to 2002, mainly from imported plant materials such as cut flowers, fruits, and vegetables. Due to Florida's sub-tropical climate, it was optimal for chilli thrips' establishment and quickly became one of the major pests of Florida blueberries and strawberries. Chilli thrips have also been reported as established in New York state, confirming their ability to overwinter and establish in areas with true winters. **This pest has been intercepted multiple times in NC, SC, and VA, but its regional establishment status outside FL, GA, and NY remains unknown.** Because of their ability to become a serious pest of blueberries and strawberries in the region, growers should be aware of their distinctive injury caused to strawberries (described below; images available in the UF IFAS publication "Chilli thrips, *Scirtothrips dorsalis* Hood (Thysanoptera: Thripidae): management practices for Florida strawberry crops."

Chilli thrips prefer to feed on younger, nutritious, softer tissues of host plants, such as on meristems or terminals. They do not feed on mature plant parts. The wounds they make in the leaves during the feeding process leads to necrosis and the development of brown to black color. Severe infestation of chilli thrips can result in complete host plant damage and crop loss.

In strawberries, chilli thrips start infesting plants early in the season. Heavy feeding causes reddening and darkening of leaf veins and petioles. With severe infestations, the entire leaf turns dark, crinkled, and deformed. In addition, chilli thrips feeding on leaves, flowers, and fruits causes leaf distortion, bronzing, and cracking of fruits, causing reduced crop yields. Larvae and adults can typically be found at their feeding site on the mid-vein or borders of the host plant leaves. Larval stages are completed in 8–10 days, whereas the pupal stage persists for 2.6–3.3 days. Pre-pupa and the pupa are sessile, non-feeding stages, and pupae can be found in the leaf litter or in the leaf curls of the damaged leaves.

Kaur, G., & Lahiri, S. (2022). Chilli thrips, Scirtothrips dorsalis Hood (Thysanoptera: Thripidae) management practices for Florida strawberry crops. *EDIS, 2022*(1). https://doi.org/10.32473/edis-in1346-2022

Kumar, V., Xiao, Y., Borden, M. A, Ahmed, M. Z., McKenzie, C. L., & Osborne, L. S. (2023). Distribution of Scirtothrips dorsalis (Thysanoptera: Thripidae) cryptic species complex in the United States and reproductive host assessment of its dominant member. *Journal of Economic Entomology, 116*(5), 1715–1726. https://doi.org/10.1093/jee/toad138

Disorders in Strawberries

An important part of integrated pest management (IPM) is accurate diagnosis of any problem situation that arises. While there are many insect pests or disease organisms (pathogens) that cause immediately evident symptoms, various disorders, caused by nutritional deficiencies, chemical injury, or environmental stresses, could be confused with diseases or insect damage. Should an incident be encountered where the symptoms are in question, steps should be taken to determine if the observed symptoms may be due to an abiotic (non-living) condition rather than a biotic (living) one. Some specific disorders in strawberries that may be misdiagnosed as diseases or insect damage are described below.

On fruit:

- Misshapen fruit (e.g., fasciation) is very common in the early season. It may be attributed to poor pollination due to cool temperatures or rainy weather, but it can also be the result of a boron deficiency. Leaf tissue analysis can help determine if a nutrient deficiency is the root cause. Growers should also watch for plant bugs, whose feeding can result in fruit deformities.
- Hail damage (**Photo A**) or high winds resulting in sand blasting of fruit is often mistaken for disease. Symptoms are often accompanied by leaf shredding to the main plant following severe weather. Open wounds on fruit and leaves can lead to entry of pathogens and subsequent disease development.
- Phyllody (vivipary; **Photo B**) is a rare phenomenon in which achenes germinate prematurely and develop into leaves on the surface of the fruit.

On leaves;

- Calcium deficiency appears on strawberry leaves as a distinct burn around the edges of the leaf.
- Boron toxicity may occur following foliar application of boron at high rates and appears as generalized leaf burn across the entire plant.
- Chemical injury caused by glyphosate exposure appears on new leaves as white edges. Exposure often occurs as a result of drift or carry over following burn-down applications in dry weather.
- Freeze injury to strawberry leaves following cold spells (**Photo C**) often appears as brown to black edges and/or misshapen leaves. This injury occurs when ice forms and row covers freeze to leaves.

Photos: Hail damage (A), phyllody (B), and freeze injury (C) in strawberry. Credit: (A, C) A. McWhirt; (B). J. Samtani.

Seasonal "At-a-Glance" Disease Guide[1]			
Developmental Stage	**Planting and Early Post-planting**	**New Leaf Growth to Pre-bloom**	**Early Bloom (10%) and into Harvest**
Diseases potentially present (Fungicides)	*Note: Pre-plant fumigation is required for management of black root rot (see "Fumigants".* Pre-plant dips are recommended for anthracnose, *Rhizoctonia,* and Phytophthora crown/root rots (see "Pre-plant Dips"). Red stele; Phytophthora crown/root rots (mefenoxam, metalaxyl, Orondis Gold, phosphites, fosetyl-Al) *Rhizoctonia* sp. (seedling root rot and basal stem rot (azoxystrobin) Charcoal rot (Rhyme) Powdery mildew (Procure, Rally, Rhyme, Quintec, Gatten, sulfur) Anthracnose fruit rot and/or crown rot[2]: - Inspect plants on arrival, and scout after establishment. - Captan and thiram are recommended for disease prevention. **IF** anthracnose comes in with transplants and is confirmed, see "Early Bloom (10%) and into Harvest" recommendations for fungicide options. Neopestalotiopsis fruit/crown rot and leaf spot: - Inspect plants on arrival, and scout after establishment. - If confirmed, thiram is recommended for disease prevention in the fall. **IF** neopestalotiopsis comes in with transplants and is confirmed, see "Early Bloom (10%) and into Harvest" recommendations for fungicide options later in the seaseon that are also effective against other diseases.	Bortytis crown rot[2]: 1. Rovral (2) 2. captan (M04) 3. thiram (M03) Common leaf spot, leaf scorch, leaf blight: (myclobutanil, captan, captan + thiophanate-methyl) Powdery mildew (Procure, Rally, Rhyme, Quintec, Torino, Gatten, propiconazole) Angular leaf spot (copper, Actigard) Red stele; Phytophthora crown/root rots (mefenoxam, metalaxyl, Orondis Gold phosphites, fosetyl-Al) Anthracnose fruit rot and/or crown rot[2]: - Scouting plants after establishment is recommended. - Captan and thiram are recommended for disease prevention. **IF** anthracnose is confirmed, see "Early Bloom (10%) and into Harvest" recommendations for more fungicide options. Neopestalotiopsis fruit/crown rot and leaf spot: - Scouting plants after establishment is recommended. **- IF** neopestalotiopsis is confirmed, use thiram for prevention.	Botrytis fruit rot[2]: 1. Fontelis, Kenja (7) 2. Luna Tranquility[3] (7 + 9) 3. Luna Sensation (7 + 11) 4. Switch (9 + 12) 5. Elevate (17) 6. Miravis Prime (7 + 12) 7. thiram (M03) 8. captan (M04) 9. Scala (9) 10. polyoxin D zinc salt (19) Anthracnose fruit rot[2]: 1. Pristine, Merivon, Luna Sensation (11 + 7) 2. Cabrio, azoxystrobin, Flint Extra (11) 3. Quadris Top, Quilt Xcel (11 + 3) 4. captan (M04) 5. Switch (9 + 12) 6. Miravis Prime (7 + 12) 7. propiconazole (3) Anthracnose crown rot[2]: 1. captan (M04) 2. thiophanate-methyl (1) 3. Quadris Top (11 + 3) 4. Miravis Prime (7 + 12) Neopestalotiopsis fruit rot and leaf rot[4]: 1. Switch (9+12) 2. thiram (M03) 3. Inspire, Rhyme, Tilt (3) Powdery mildew (Procure, Rally, Rhyme, Quintec, Torino, Gatten) Common leaf spot, leaf scorch, leaf blight: (myclobutanil, captan, captan + thiophanate-methyl)

[1] FRAC codes are listed in parentheses for all products listed for anthracnose and Botrytis diseases. Active ingredient (a.i.) names, rather than trade names, are provided when multiple trade name products with the a.i. are available. [2] See ***RESISTANCE MANAGEMENT RECOMMENDATIONS ON PAGES 30 AND 49.***

[3] Luna Tranquility is not registered for use in Louisiana. [4]Section 2(ee) Recommendations for Switch and Thiram SC are available for many states in the Southeast. Inspire, Rhyme, and Tilt do not have labels for *Neopestalotiopsis* but have been shown to suppress *Neopestalotiopsis* when used to manage other diseases.

Seasonal "At-a-Glance" Arthropod Guide[1]

Developmental Stage	Post-planting (Fall/early to mid-winter)	Pre-harvest - Bloom (Late winter to early spring)[3]	Harvest
Pests potentially present (Insecticides/ Miticides)	Crickets (carbaryl, malathion) Cutworms (carbaryl, Coragen, Entrust, malathion, *Bt*, Intrepid) Cyclamen mites (Portal, abamectin) Fire ants[2] (Extinguish Professional Fire Ant Bait, Esteem Ant Bait) Twospotted spider mites:[3] 1. Acramite/Vigilant, Kanemite, Magister, Nealta (all stages) 2. Oberon, Savey, Zeal (eggs and juveniles) 3. Portal, Agri-Mek (juveniles and adults) 4. M-Pede, horticultural oils (all stages; OMRI-listed) 5. Predatory mites	Aphids[4] (malathion, Sivanto, imidacloprid, Platinum, insecticidal soap) Fire ants[2] (Extinguish Professional Fire Ant Bait, Esteem Ant Bait) Flower thrips[4] (Entrust, Radiant, Exirel, minute pirate bugs) Slugs/snails (baits containing carbaryl, metaldehyde, and/or iron phosphate) Strawberry clippers[4] (bifenthrin, Danitol, carbaryl) Twospotted spider mites[5]: See "Post-planting" column.	Fire ants[2] (Extinguish Professional Fire Ant Bait, Esteem Ant Bait) Sap beetles[6] (cultural control, Rimon) Slugs/snails (baits containing carbaryl, metaldehyde, or iron phosphate) Spotted-wing drosophila (bifenthrin, Danitol, Entrust, Malathion and generics, Radiant) Tarnished plant bugs[7] (Actara, Assail, Avaunt, bifenthrin, Danitol, Rimon, Transform) Twospotted spider mites[5]: See "Post-planting" column.

[1] Management of strawberry arthropod pests is based on pest presence in the field. There is no preventive spray program, and listed materials only work if target pests are present! **Treat only if damaging populations are present.** Thorough regular scouting is necessary to detect pests early before infestations build to damaging levels.

[2] Fire ant baits work slower than contact materials but provide longer term management by sterilizing the queen and preventing larvae from developing over a 4- to 8-week period. Apply baits as soon as ant foraging is noted in the spring. Ants must be actively foraging for baits to be effective.

[3] A thorough inspection of planting material is necessary to avoid introducing mites from the nursery into production fields. Scouting to determine the extent of infestation and the presence of eggs is necessary. Materials in groups 1 and 2 that control all stages are the primary tools for spring infestations. Fall use could affect the number of applications allowed in the spring. The fourth and fifth groups of materials are organically acceptable (**OMRI-**listed); coverage is very important for the efficacy of these materials. Resistance management is crucial for all miticides. Rotate to an insecticide from a different new mode of action (MOA) (IRAC group) if more than one treatment is necessary (see tables for IRAC groups). Follow resistance management guidelines on labels. Native predatory mites may be effective. They may be augmented with mites from commercial sources. Carbaryl, pyrethroids, and neonicotinoids are highly toxic to predatory mites.

[4] Aphid, flower thrips, and strawberry clipper populations have to be very high to cause yield loss in strawberry. Spraying insecticides during bloom is hazardous to honey bees; follow instructions on pesticide labels to minimize damage to honey bees.

[5] As weather begins to warm, scout regularly for mites. Follow label instructions about resistance management carefully when using miticides.

[6] Sap beetles are attracted to overripe fruit. Keeping fruit picked and removed from the field will reduce problems with sap beetles.

[7] Tarnished plant bugs can feed early in the spring on flowers and developing weed seeds. Wild radish and wild mustard are favored late winter hosts. Reducing weeds and alternate hosts in and around fields will reduce populations; however, this should be done prior to weed/alternate host flowering to avoid movement of plant bugs from these hosts to strawberries. See note above about honey bees.

Pre-planting: Arthropod, Disease, Nematode, and Weed Management			
Pest/Problem	**Activity**	**Effectiveness***	**Comments**
Anthracnose Angular leaf spot Fusarium wilt Mites: cyclamen mites and spider mites Neopestalotiopsis fruit/crown rot & leaf spot Phytophthora crown rot Viruses	Use disease- and arthropod-free plants	Importance: E Efficacy: E	Use of certified plants or plants produced in a similarly stringent program is the most important method to prevent these diseases. Inspect plants thoroughly for disease symptoms, particularly lesions on stems and leaves, and mites.
Phytophthora crown rot	Site selection, preparation, and water management	Importance: E Efficacy: E	Phytophthora crown rot can be particularly problematic in low areas that drain poorly. Choose a planting site that has good drainage and/or take measures to improve drainage (e.g. drain tile). Also, do not overwater in order to reduce conditions favorable for Phytophthora crown rot.
Botrytis fruit rot (gray mold)	Remove flowers and dead tissue present on transplants	Importance: ND Efficacy: ND	This practice may help to reduce Botrytis fruit rot.
Nematodes	Sample soil for nematode analysis	Importance: G	Sample soils for nematode analysis through local state services. Analysis results can help determine the best fumigant or IPM management plan to use.
Nematodes Neopestalotiopsis fruit/crown rot & leaf spot Soilborne pathogens (*Pythium, Phytophthora, Fusarium, Rhizoctonia*)	Practice crop rotation	Importance: G Efficacy: G	Rotating fields with non-host crops for 2 to 3 years can suppress nematode populations and reduce black root rot and other disease problems. Crop rotation is essential if fumigation is not practiced.
Nematodes Neopestalotiopsis fruit rot & leaf spot Root and crown rot disorders (black root rot; Phytophthora crown rot) Weeds	Pre-plant fumigation and laying down plastic mulch	Efficacy: E or G (*Neopestalo-tiopsis)*	See fumigants table below. Consult with custom applicators and/or Extension agents for product and rate recommendations.
Anthracnose fruit rot	Use resistant varieties	Importance: E Efficacy: G	Cultivars with various levels of resistance to anthracnose fruit rot have been identified (see Cultivar Resistance to Anthracnose table below); however, cultivar performance against this disease varies depending on location. ***Growers interested in trying these cultivars are STRONGLY advised to test a small number of plants of the desired cultivar(s) to determine performance before heavily investing in a specific cultivar to place into significant production.***
Nutrient deficiencies	Sample soil for nutrient analysis	Importance: E Efficacy: E	Sample soils for nutrient profiles through local state services. Analysis results can help determine the best fertilizer program and necessary adjustments for soil pH. Proper fertilization impacts plant health.

Pre-planting: Arthropod, Disease, Nematode, and Weed Management			
Pest/Problem	**Activity**	**Effectiveness***	**Comments**
Nematodes Soilborne plant pathogens Weeds (grasses, broadleaf weeds, yellow and purple nutsedge)	Use of anaerobic soil disinfestation (ASD)	Efficacy: F - E	ASD is a potential alternative to soil fumigation. However, practical methods to employ ASD on-farm are still being researched. Growers interested in testing ASD on a small scale should learn more (see Anaerobic Soil Disinfestation below) and contact their local county Extension service for guidance.
Nematodes Soilborne plant pathogens Weeds (grasses, broadleaf weeds, yellow and purple nutsedge)	Plant brassicaceous cover crops or incorporate mustard seed meal into soil	Efficacy: F - G	Cover cropping with brassicaceous crops or soil incorporation with mustard seed meal may help reduce stunting and yield losses from some plant-parasitic nematodes and root diseases such as black root rot. Growers interested in implementing these techniques should read more about these techniques (see Cover Cropping and Soil Incorporation Techniques below) and should contact their local county Extension service for guidance.
Nematodes Soilborne pathogens (*Pythium, Phytophthora, Fusarium, Rhizoctonia*) Weeds (annual)	Solarization	Efficacy (nematodes and pathogens): ND Efficacy (weeds): G - VG	Solarization is a potential alternative to soil fumigation but does not provide the same level of effectiveness. When used in combination with techniques such as ASD, greater efficacy may be observed. Growers interested in implementing these techniques should read more about these techniques (see Soil Solarization below) and should contact their local county Extension service for guidance.
Viruses	Begin with virus-free plants	Efficacy: E	Invest in quality plants from reputable nurseries that practice vector exclusion and disease management strategies and that screen for viruses. Read more about strawberry viruses and their management in Viruses in Strawberries below.

*Efficacy/Importance ratings: E = excellent, VG = very good, G = good, F = fair, P = poor, NC = no control, and ND = no data.

Cultivar Resistance to Anthracnose

Most commercial strawberry cultivars, such as Chandler and Camerosa, do not have resistance to anthracnose. Over the years, researchers in various locations have tested a number of strawberry cultivars for resistance to anthracnose fruit rot. Cultivars with various levels of resistance have been identified (see table); however, results have varied depending on location. The table to the right lists cultivars that were shown to have medium resistance (MR) or to be resistant (R) in at least one of the reviewed trials and the southeastern states where these cultivars are known to be grown on some acreage. In some trials, resistance was based on whole plant collapse caused by *Colletotrichum acutatum* following inoculation at planting. ***It is not currently known if these varieties are suitable for production in southeastern states.***

Due to observed differences in performance, it is STRONGLY advised that growers interested in these cultivars test a small number of plants of the desired cultivar(s) to determine performance before heavily investing in a specific cultivar to place into significant production.

Resistant	Medium Resistance to Resistant	Medium Resistance
Flavorfest[KY/NC/SC/VA]	Dover	Carmine
Florida Belle	Festival	Florida Brilliance[FR; LA/NC/SC]
Florida Elyana	Florida Radiance[FR; GA/LA/NC/SC]	Ovation
Pelican	Winterstar	Rubygem
Prado		Sweet Charlie[AR/MS/TN/VA]
Sweet Ann		
Sweet Sensation[ED; FR; AL/GA]		
Winter Dawn[FR]		

ED = soft and easily damaged by rain; FR = freeze risk due to early flowering

States in which cultivars are known to be grown on some acreage: AR = Arkansas, GA = Georgia, KY = Kentucky, LA = Louisiana, MS = Mississippi, NC = North Carolina, SC = South Carolina, TN = Tennessee, VA = Virginia. (*This is not a comprehensive list for all southeastern states.*)

Anaerobic Soil Disinfestation

Anaerobic soil disinfestation (ASD) is a potential alternative to traditional fumigants. However, practical methods to employ ASD on farm are still being researched. ***Growers interested in testing this technique on a small scale should contact their local county Extension service for guidance.*** ASD involves incorporating very high volumes of a carbon source material into soil when beds are formed and plastic mulch is laid (***at least*** 30 days before transplanting), saturating the soil for the duration of treatment (~21 days), and then aerating the soil by punching planting holes 10 to 14 days prior to transplanting. Suitable carbon sources may vary by region and are still being identified. Nitrogen fertilizer application in beds may need adjustment depending on the carbon source material used. Additional details on ASD are available in the publication "Anaerobic Soil Disinfestation for Management of Soilborne Diseases in Strawberry Production" **Note: While ASD is technically a pre-plant treatment, treatments are implemented earlier than most pre-plant treatments; planning should begin 6 to 7 weeks before transplanting for implementation by late July/early August.**

Cover Cropping and Soil Incorporation Techniques

Planting 1-2 cycles of a brassicaceous cover crop ('Caliente' mustard, for example) before transplanting strawberry may help reduce stunting and yield loss from plant-parasitic nematodes and root diseases such as black root rot. However, treatment efficacy depends upon methods, particularly cover crop biomass, timing and extent of cover crop destruction and incorporation, and soil moisture at incorporation. Mustard seed meals incorporated into beds at least 21 days before transplanting have also reduced black root rot. Multiple years of research suggest banded rates of 1,000-2,000 lb/A are needed. Additional information on the use of cover crops is available in the publication "Sustainable Practices for Plasticulture Strawberry Production in the South." ***Growers interested in implementing these techniques should contact their local county Extension service for guidance.*** **Note: While use of cover crops and soil incorporation with mustard seed meal are technically pre-plant treatments, treatments are implemented earlier than most pre-plant treatments; planning should begin 6 to 7 weeks before transplanting for implementation by late July/early August.**

Soil Solarization

Soil solarization is a passive process that uses heat and moisture to kill or inactivate certain pests, including some nematodes, soilborne plant pathogens, and annual weeds, present in the soil, and thereby reduce or eliminate the incidence or occurrence of those pests in the succeeding growing season. Soil solarization involves covering moistened soil with clear polyethylene (plastic) 1 to 1.25 mils thick for a period of 6 to 8 weeks. The edges of the plastic should be covered with soil and/or weighed down to trap moisture and heat. Soil moisture should be maintained at 70% field capacity during solarization using drip irrigation. The goal of this process is to raise the soil temperature under the plastic to levels much higher than the ambient air temperature for an extended period of time, while providing adequate moisture, to expose target pests to conditions that cause inactivity or death. Due to the length of time required for the solarization process, implementation should begin 7 to 9 weeks (typically late July/early August) before transplanting. Growers may choose to use the clear plastic as mulch for their strawberry beds but should keep in mind that soil temperatures using the clear plastic may be lower during the winter relative to black plastic mulch. Additional information on soil solarization and challenges associated with this treatment can be found in the publication "Introduction to Soil Solarization." ***Growers interested in testing this technique on a small scale should contact their local county Extension service for guidance.***

Viruses in Strawberries

A number of viruses are capable of infecting strawberries; when these viruses accumulate in plants, they could cause significant yield losses. Viruses have not commonly been problematic in strawberry production in the Southeastern U.S. However, aphid- and whitefly-transmitted viruses can become a problem, primarily in multi-year fields as viruses tend to accumulate over time. This is increasingly important with the recent discovery of multiple new viruses that are transmitted by these vectors (Medberry and Tzanetakis, 2022; Medberry, et al., 2023). The most common viruses in the Southeast are beet pseudo-yellows virus (BPYV), strawberry crinkle virus (SCV), strawberry mild yellow edge virus (SMYEV), strawberry mottle virus (SMoV), strawberry necrotic shock virus (SNSV), strawberry pallidosis associated virus (SPaV), and strawberry vein-banding virus (SVBV); of these, BPYV, SPaV, and SMoV are the most prevalent (Martin and Tzanetakis, 2013). In addition, the movement of non-certified planting material across states and counties increases the potential for virus epidemics to occur.

Modern strawberry cultivars do not show symptoms in single-virus infections. However, when multiple viruses (mixed infections) accumulate in plants, symptoms and yield decline become obvious. Symptoms of mixed infections may include leaf discoloration (yellowing or chlorosis), stunting, a lack of marketable fruit, weakened plants, and/or plant death. Photos showing symptoms of mixed infections of SMoV and SMYEV are available in the Virginia Cooperative Extension publication "Mixed Infection of Strawberry Mottle Virus and Strawberry Mild Yellow Edge Virus in the Southeastern United States" and in the *Plant Disease* article "Characterization and Recent Advances in Detection of Strawberry Viruses."

Viruses are not typically problematic in strawberries produced in an annual system when beginning with virus-tested planting stock. In the past twenty years, all strawberry virus epidemics started from second-year fields or nursery stock. Multi-year fields are almost guaranteed to harbor virus-infected plants. Growers who opt for a multi-year production cycle need to monitor for virus vectors - primarily aphids and whiteflies - and manage them to avoid establishment in the field.

Management of viruses in annual strawberry production and production nurseries can largely be accomplished through exclusion and vector management.

In annual field production:

- ***Always begin with virus-tested planting stock***. Planting stock is the most important part of the production scheme. If planting stock is tested for viruses, even if plants become infected in the field, effects in yield are typically minimal as there is not enough time for symptoms to develop. The exception would be if plants become infected very early in the season.
- ***Invest in quality plants from reputable nurseries*** that practice vector exclusion and disease management strategies and that screen for viruses. A little research up front can save a lot of money in the end.

In production nurseries:

Nurseries are encouraged to follow standards regarding production, virus detection and testing, and vector management in nurseries. Visit the National Clean Plant Network (NCPN) - Berries website at https://www.nationalcleanplantnetwork.org/berries for more information.

- ***Inspect, sample, and test planting fields for target viruses.*** Visit https://www.nationalcleanplantnetwork.org/certification for suggested inspection times, sampling protocols, and certifying agencies.
- ***Follow best management practices that target virus vectors***, particularly strawberry aphids and the greenhouse whitefly, to help reduce the chance of infection. Visit https://www.nationalcleanplantnetwork.org/certification for specific management practices relevant to various production materials and practices.

Martin, R. R., & Tzanetakis, I. E. (2013). High risk strawberry viruses by region in the United States and Canada: Implications for certification, nurseries, and fruit production. *The American Phytopathological Society, 97*(10), 1358–1362. https://doi.org/10.1094/PDIS-09-12-0842-RE

Medbery, A., & Tzanetakis, I. E. (2022). Identification, characterization, and detection of a novel strawberry cytorhabdovirus. *Plant Disease, 106*(11), 2784–2787. https://doi.org/10.1094/PDIS-11-21-2449-SC

Medbery, A., Srivastava, A., Diaz-Lara, A., Rwahnih, M. A., Villamor, D. E. V., & Tzanetakis, I. E. (2123). *Plant Disease, 107*(3), 620–326. https://doi.org/10.1094/PDIS-05-22-1078-SC

Nematodes in Strawberries

Several plant-parasitic nematodes can affect strawberries in the southeastern U.S. Sting nematode (*Belonolaimus longicaudatus*) is the most serious nematode pest, causing severe stunting (**Figure A**) and significant yield loss. Roots often appear pruned with swollen root tips (**Figure B**) and can be easily pulled from the soil. This nematode can be especially damaging in sandy soils and is considered one of the main strawberry pests in Florida. Due to the severe damage caused by this nematode, even at low population density, finding a single sting nematode in soil from a strawberry field warrants action. Occasionally, stubby root nematodes (Trichodorids) can also cause similar damage (pruned roots, stunted plants) (see Disease Photo pages at end of guide). The northern root-knot nematode (*Meloidogyne hapla*) is the main root-knot species affecting strawberries and can be diagnosed by the presence of small root galls (see Disease Photo pages at end of guide). More common root-knot species in the south, like the southern root-knot nematode (*M. incognita*), are not known to cause damage to strawberries. Lesion nematodes, especially *Pratylenchus penetrans*, can also be found on strawberries and cause necrotic lesions on roots that may predispose roots to secondary infection with fungal pathogens.

In addition to the previous root-feeding nematodes, strawberries can also be severely damaged (**Figure C**) by foliar nematodes (*Aphelenchoides besseyi* and *A. fragariae*). Typical symptoms caused by these nematodes are bushy, distorted plants with deformed twisted leaves and little to no flower and fruit production (**Figure D**). Damage by these nematodes can be easily confused with mite or thrips damage. Foliar nematodes are usually restricted to high-humidity environments.

Photo credits: J. Desaeger, University of Florida – IFAS.

Pre-plant Dips

Several products are registered as plant dips to manage pathogens or to protect plants just prior to field setting, but only a limited amount of research has been done with plant dips. In general, these treatments are not recommended except under specific circumstances, for example, if a disease has been diagnosed to be on the transplants. Products not labeled for dip treatments should not be used for dips, since poor plant performance has been observed in research trials.

Zivion S (FRAC 48) — Zivion is a liquid formulation of natamycin used for management of anthracnose (*Colletotrichum* spp.), Verticillium wilt, and charcoal rot (*Macrophmina phasiolina*). The active ingredient is derived from the bacterium *Streptomyces natalensis* and produced by microbial fermentation. **Zivion may not be registered for use in all states. Check state registration prior to use.** Apply as root or whole plant dip treatment prior to planting. Mix 6 to 12 fl oz (0.04 to 0.08 lb natamycin) of Zivion S per 10 gal of water. Dip plants for a minimum of 2 minutes, but no more than 5 minutes. Plant treated plants after dip application. Transplants should be washed to remove excess soil prior to dipping.

Switch 62.5WG (FRAC 9 + 12) — Switch offers options for treating plants known to be infected with *Colletotrichum* species (anthracnose) and has shown good efficacy in reducing losses due to the crown rot pathogen in bare root transplants (*Colletotrichum gloeosporioides*). Use 5 to 8 fl oz/100 gal water. Wash transplants to remove excess soil prior to dipping. Completely immerse planting stock in dip solution. Dip or expose plants for a minimum of 2 to 5 minutes. Do not reuse solution. Growers must ensure proper disposal of root dip waste. Plant immediately after treatment. Delayed planting could cause plant stunting.

Quadris (FRAC 11) — Mix 5 to 8 fl oz/100 gal of water. Dip plants for 2 to 5 minutes. Transplant treated plants as quickly as possible. This treatment has been developed for bare root transplants with a known problem of anthracnose. The dip is a whole plant dip, and some growers do not re-use the water for fear of spreading angular (bacterial) leaf spot and other diseases. It is reasonable to expect these fungicides to have some *Rhizoctonia* suppressive activity, but there are no research results to demonstrate a benefit. For managing *Rhizoctonia*, a root dip should suffice, rather than dipping whole plants. *Rhizoctonia* (and the black root rot problem) builds up over time; it is doubtful that a root dip would offer much benefit for season long control. Growers must ensure root dip waste is properly disposed.

Phosphites/fosetyl-Al (FRAC P07, formerly FRAC 33) — Dip plants in 2.5 lb/100 gal (Aliette WDG), 2 pt/100 gal (ProPhyt), or 2.5 to 5.0 pt/100 gal (Phostrol) for 15 to 30 minutes and then plant within 24 hours after treatment. This treatment should help to suppress *Pythium* and *Phytophthora* problems.

Little data are available for other plant dip products, including **OxiDate**, and it is doubtful that they offer management of root diseases. In most cases, root pathogens are internal to the tissue and are not controlled by surface disinfectants.

Pre-planting and Early Post-planting: Nematode Management						
Pest/Problem	**Management Options**	**Amount of Formulation per Acre**	**Effectiveness**	**REI**	**PHI**	**Comments**
Nematodes (root-knot, lesion, sting, and foliar)	heat-killed *Burkholderia* spp. strain A396 (Bronte) (Majestene)	18 to 24 fl oz 4 to 8 qt	See comments	4 hr	0 days	Majestene is **OMRI-listed.** Products are biological nematicides. They have not been extensively field-tested on strawberry in the Southeast and Mid-Atlantic states, but research to date suggests useful activity against major plant-parasitic nematodes. Apply via drip or incorporated spray. Can be applied prior to planting, at planting or shortly thereafter, and again later in the season. Higher rates are likely more effective, and repeated applications also increase the extent and duration of nematode control. If nematode populations are high, it should be combined with other products.
	fluensulfone (Nimitz)	3.5 to 7 pt/treated A	See comments	12 hr	0 days	Nimitz is a selective nematicide. It has not been extensively tested on strawberry in the Southeast and Mid-Atlantic states, but research on other crops in these areas and on strawberry elsewhere suggests moderate to good activity – not quite as effective as soil fumigant standards – against most major plant-parasitic nematode species. Apply via drip or incorporated spray at least 7 days before planting. Soil temperature must be 60°F or above. Soil incorporation in the top 6-8 inches is critical. Irrigating (0.5-1 inches) 2-5 days after application is recommended. Do not apply more than 1 application per crop. Do not apply more than 3.5 lb fluensulfone per acre per calendar year.

Pre-planting and Early Post-planting: Nematode Management						
Pest/Problem	**Management Options**	**Amount of Formulation per Acre**	**Effectiveness**	**REI**	**PHI**	**Comments**
Nematodes (root-knot, lesion, sting, and foliar) (continued)	fluopyram (Velum Prime)	6 to 6.8 fl oz	See comments	12 hr	0 days	Fluopyram has fungicideal and nematicidal activity. Velum Prime has not been extensively tested on strawberry in the Southeast and Mid-Atlantic states, but research on other crops in these areas and on strawberry elsewhere suggests moderate to good activity. Apply via drip or incorporated spray. Can be applied prior to planting, at planting or shortly thereafter, and again later in the season. However, do not apply more than 13.7 fl oz of product per acre per year. Do not apply more than 0.446 lb of fluopyram per acre per year regardless of formulation or method of application. *Note*: Luna Sensation and Luna Tranquility are also fluopyram products used as fungicides. **FRAC 7.**
	Purpureocillium lilicanum strain 251 (LALNIX ACT DC)	10.25 fl oz	See comments	See label	0 days	**OMRI-listed.** Lalnixact is a biological nematicide approved for organic strawberry production. It has not been extensively field-tested on strawberry in the Southeast and Mid-Atlantic states, but research to date suggests useful activity against major plant-parasitic nematodes. Apply via drip or drench. Can be applied prior to planting, at planting or shortly thereafter, and again later in the season. Repeated applications increase the extent and duration of nematode control. If nematode populations are high, it should be combined with other products.

Pre-planting and Early Post-planting: Nematode Management						
Pest/Problem	**Management Options**	**Amount of Formulation per Acre**	**Effectiveness**	**REI**	**PHI**	**Comments**
Nematodes (root-knot, lesion, sting, and foliar) (continued)	*Purpureocillium lilicanum* strain PL11 (NemaClean 10% WP)	0.25 to 2 lb	See comments	12 hr	0 days	**OMRI-listed.** NemaClean is a biological nematicide approved for organic strawberry production. It has not been extensively field-tested on strawberry in the Southeast and Mid-Atlantic states, but research to date suggests useful activity against major plant-parasitic nematodes. Apply via drip or drench. Can be applied prior to planting, at planting or shortly thereafter, and again later in the season. Repeated applications increase the extent and duration of nematode control. If nematode populations are high, it should be combined with other products.

Fumigants

New fumigant labels require extensive risk mitigation measures including fumigant management plans (FMPs), buffer restrictions, worker protection safety standards, and other measures. Details are on the labels and at https://www.epa.gov/soil-fumigants. Some fumigants are registered for use on multiple crops but with crop- or soil-type -specific rates; others are registered for use on specific crops and/or in certain states only. Not all products are registered for use in all states. Follow all labels carefully.

Registered Fumigants or Fumigant Combinations for Managing Soilborne Nematodes, Diseases, and Weeds in Plasticulture Strawberries[1]

Product	Rate per Treated Acre[2]		Relative Efficacy[3]			
	Volume (gal)	Weight (lb)	Nematodes	Disease	Nutsedge	Weeds: Annual
Pic-Clor 60 (chloropicrin + 1,3-dichloropropene)	48.6	588	E	E	F	G
Pic-Clor 60 EC[4] (chloropicrin + 1,3-dichloropropene)	42.6	503	E	E	F	G
Pic-Clor 80 (chloropicrin + 1,3-dichloropropene)	34	440	G	E	F	F
InLine[4] (1,3-dichloropropene + chloropicrin)	29 to 57.6 (*see label*)	325 to 645 *(see label)*	E	E	F	G
Telone C-35 (1,3-dichloropropene + chloropicrin)	39 to 50	437 to 560	E	E	F	F
chloropicrin[5] + metam sodium[5]	see labels + see labels	see labels + see labels	VG	E	G	VG
chloropicrin[5]	see labels	see labels	F	E	F	P
Tri-Pic 100EC[4] (chloropicrin)	8 to 24	100 to 300	F	E	P	P
metam potassium[5]	see labels	see labels	G	G	F	G
metam sodium[5]	see labels	see labels	G	G	F	G
Dominus[6] (allyl isothiocyanate)	25 to 40*	212 to 340*	F	G	P	G
Telone II (1,3-dichloropropene)	15 to 27	153 to 275	E	P	P	P
Telone EC[4] (1,3-dichloropropene)	9 to 24*	91 to 242*	E	P	P	P

[1] Fumigants with lower efficacy against weeds may require a complementary herbicide or hand-weeding program, although use of virtually impermeable film (VIF) or totally impermeable film (TIF) may increase weed control, particularly with Telone C35. Refer to the Herbicide Recommendation section of this guide for directions pertaining to herbicide applications. Telone can persist more than 21 days under cool or wet soil conditions.

[2] Rates can sometimes be reduced if products are applied with VIF or TIF.

[3] Efficacy Ratings: The efficacy of a management option is indicated by E = excellent, VG = very good, G = good, F = fair, P = poor, and ND = no data. These ratings are benchmarks; actual performance will vary.

[4] Product is formulated for application through drip lines under a plastic mulch; efficacy is dependent on good distribution of the product in the bed profile.

[5] Metam potassium can be Metam KLR, K-Pam, Sectagon K54 or other registered formulations and should be used in soils with high sodium content. Metam sodium can be Vapam, Sectagon 42, Metam CLR or other registered formulations. Chloropicrin can be applied by itself (e.g. Pic100) but is usually applied as a mixture with 1,3-dichloropropene.

[6] Dominus is registered but there is limited experience with the product through university or independent trials in our region; growers may want to consider this on an experimental basis. Planting interval is 10 days. The active ingredient allyl isothiocyanate is similar to the active ingredient in metam sodium products (methyl isothiocyanate) and is likely to behave in a similar manner with a similar pest control profile.

* Labelled rates are per *broadcast-equivalent* acre, NOT per treated acre.

Fungicide Resistance Management Recommendations (See page 53 for additional details)

Botrytis cinerea (Botrytis fruit rot (sometimes referred to as gray mold) and Botrytis crown rot historically has a high potential to develop resistance, and recent data suggest a high percentage of strains are resistant to several important fungicides. Therefore, it is important to give these recommendations serious consideration:

1. Thiram (FRAC M03) and captan (M04) should serve as the backbone for a season-long spray program.
2. Limit the number of times at-risk fungicides, such as FRAC 3, 7, 11, and 12 fungicides, are applied in a single year.
3. Tank-mix a broad-spectrum fungicide such as **captan or thiram with Topsin M (a benzimidazole fungicide, FRAC 1) since Topsin M no longer has Botrytis activity due to resistance but is helpful for several early season foliar diseases, if present.**
4. Resistance profiles vary from farm-to-farm. Botrytis fruit rot samples can be submitted to diagnostic laboratries at both Clemson University and the University of Georgia for restistance profile testing. (See Southeastern Region University Diagbostic Laboratories.)

It is currently suggested that the strobilurin (QoI) fungicides (FRAC 11; e.g., Quadris, Cabrio, Merivon, Pristine, and **Quadris Top) not be used to control Botrytis and other disease problems but be saved for use in controlling anthracnose fruit rot (AFR) when there is a high potential for disease pressure. Captan or thiram should help suppress anthracnose when utilized in Botrytis or other disease control applications, but the QoI fungicides are currently the most effective materials for control of anthracnose**. Some of these QoI fungicides may have activity against multiple pathogens other than the anthracnose pathogens, but unless anthracnose occurs in conjunction with these other diseases of concern, it is suggested that the QoI fungicides not be used. With only 4-5 total applications of the QoI fungicides per crop, it is an imperative that they be utilized effectively. Also, resistance management is extremely important with the QoI fungicides; make sure to follow all resistance management guidelines. Recently, we have documented reduced activity with azoxystrobin (Quadris) with certain strains of the AFR pathogen. Other strains appear to be resistant to all QoI fungicides. Cabrio, Merivon, or Pristine have offered better control of AFR in recent research efforts AND if the strains are not resistant to QoI funfgicdes. If resistance is known, see page 53 for additional details.

Anthracnose crown rot (ACR) (*Colletotrichum gloeosporioides* species complex) — Most plantings are rarely at risk for ACR. Thus, fungicides may not be needed. In most cases, contaminated plant sources are identified before or soon after planting. Know your plant source. ACR primarly comes in with transplants. If present, anthracnose on plants can cause petiole lesions (black sunken areas), stunting, and plant death. Fall fungicide applications will be required for *Colletotrichum* only if plant source problems are identified, usually appearing as symptomatic plants or assayed for quiescent infections. **Research results show that QoIs are more effective against the fruit rot pathogen (*Colletotrichum acutatum* species complex) compared to the crown rot pathogen. Captan, Topsin M, and Switch are effective for controlling the crown rot pathogen**. In general, it is BEST to save the QoI (FRAC 11) chemistry for spring applications and protect the fruit if anthracnose ('*acutatum*') is known to be present. Failure in management of some '*acutatum*' populations has been observed due to resistance to the QoI fungicides (FRAC 11) (see above). See section on Pre-plant Dips for anthracnose. Note: In some geographic locations, *Colletotrichum acutatum* species complex has been found to cause ACR; this may have an effect on fungicide efficacy.

Powdery mildew — Monitor the field for the first signs of powdery mildew (leaf distortion and discoloration). Mildew in the fall does not appear to cause significant damage and may not reappear in the spring. ***Therefore, most growers will not need to spray for powdery mildew***. However, fields have been observed in the fall with severe foliar disease incidence, and plant productivity may then be hampered, justifying control measures. Likewise, if powdery mildew pressure occurs in the spring and affects the fruit, the fruit will have a dull appearance and be unmarketable unless managed well. High tunnels favor powdery mildew development. **QoIs, in general, are registered and effective for powdery mildew but are not recommended when only powdery mildew is present to avoid fungicide resistance selection in the anthracnose and *Botrytis* pathogens.**

Planting and Early Post-planting: Disease Management						
Pest/Problem	**Management Options**	**Amount of Formulation per Acre**	**Effectiveness**	**REI**	**PHI**	**Comments**
NOTE: A treated acre is the amount of area under the plastic, i.e. in most strawberry fields there is about one acre under plastic on two acres of land.						
Red stele; Phytophthora crown/root rots	mefenoxam (ReCon Bold SL) (Ridomil Gold SL) (Thrive 4M) (Ultra Flourish)	 1 pt 1 pt 15.7 fl oz 2 pt	VG	 See label See label See label See label	 0 days 0 days 0 days 0 days	Apply in sufficient water in drip applications to move the fungicide into the root zone**. **See labels for instructions regarding rates to be used in drip and band applications.**** REI varies and is dependent upon method of application. See labels for limits of mefenoxam-containing products per crop. **FRAC 4.** **ReCon Bold SL:** Do not exceed 3 pt per acre per year or 3 applications per crop. See label for other limits. **Ridomil Gold SL:** Do not exceed 3 applications per crop. Preliminary research indicates that application after transplanting may cause stunting. **Thrive 4M:** Do not exceed 3 applications per acre per year at reduced rate. **Ultra Flourish:** Do not exceed 6 pt per acre per year.
	metalaxyl (ReCon 4 F)	1 qt	VG	See label	See label	Apply in sufficient water in drip applications to move the fungicide into the root zone**. **See labels for instructions regarding rates to be used in drip and band applications.**** REI varies and is dependent upon method of application. Do not exceed 3 qt of product per treated acre per year. **FRAC 4.**
	oxathiapiprolin + mefenoxam (Orondis Gold)	20.0 to 62.0 fl oz	VG	See label	14 days	Product should be applied through drip application. Do not apply more than two sequential applications before switching to a product with a different mode of action. Do not apply more than 2 applications per year at the maximum rate. *In new plantings*, the first application should be made soon after planting and the second application should be made 30 days before the beginning or harvest or at fruit set. *In established plantings*, the first application should be made in the spring before first bloom and the second application should be made after harvest. See label for other restrictions and limits. **FRAC 49 + 4.**

Planting and Early Post-planting: Disease Management						
Pest/Problem	**Management Options**	**Amount of Formulation per Acre**	**Effectiveness**	**REI**	**PHI**	**Comments**
Red stele; Phytophthora crown/root rots (continued)	phosphites (ProPhyt) (Phostrol) [*other products available*]	(foliar) 2 to 4 pt 2.5 to 5.0 pt *See labels*	F	4 hr 4 hr *See labels*	0 days See label *See labels*	Listed rates are for foliar applications. See product labels for rates specified for use for dip applications. Phosphite-based chemicals are not as effective as Ridomil Gold. Consider phosphites if the pathogen is known to be resistant to mefenoxam or if root systems are poor AND foliage is healthy for chemical uptake. Do not apply more than 30 lb of Aliette WDG per acre per season. Check other product labels for season limits. **Check the registration status of products prior to use. Not all products are registered for use in all states. FRAC P07.**
	fosetyl-Al (Aliette WDG)	(foliar) 2.5 to 5.0 lb	F	12 hr	12 hr	
Rhizoctonia sp. (seedling root rot, basal stem rot)	azoxystrobin (Quadris) [*other products available*]	0.40 to 0.80 fl oz/ 1,000 row feet *See labels*	F	4 hr *See labels*	0 days *See labels*	This is a drip irrigation application method. Application may be beneficial for plug plants with poor root systems or plants placed into non-fumigated beds or beds with excess water in heavy soils. See label for specific rate applications and limits for banded and in-furrow applications based on row spacing. **FRAC 11.**
Charcoal rot	flutriafol (Rhyme)	7 fl oz	F	12 hr	0 days	Product is to be applied through drip irrigation. Do not apply more than 4 applications per year. Do not apply more than 28 fl oz of product per acre per year. **FRAC 3.**
Powdery mildew only	**Powdery mildew** is not a common problem at this time of year; it may come in on transplants but usually does not persist or present an economic problem in open fields. There is a greater risk of powdery mildew in high tunnels. FRAC 11 products or product mixtures with FRAC 11 fungicides are labeled for use against powdery mildew but are not recommended for powdery mildew management in order to optimize FRAC 11 fungicide use for AFR management.					
	triflumizole (Procure 480SC)	4 to 8 fl oz	E^R	12 hr	1 day	Check label for prohibited rotational crops. Do not plant leafy or fruiting vegetables within 30 days after application. Do not plant bulb or root vegetables within 60 days after application. Do not plant cotton, small cereal grains and all other crops not registered within one year of application. Do not apply more than 4 applications of product per crop per year. Do not apply more than 32 fl oz of product per crop per year. **FRAC 3.**
	myclobutanil (Rally 40WSP)	2.5 to 5 oz	E^R	24 hr	1 day	Rally is registered for control of leaf spot, leaf blight, and powdery mildew. Do not apply more than 30 oz of product per acre per year. **FRAC 3.**

Planting and Early Post-planting: Disease Management						
Pest/Problem	**Management Options**	**Amount of Formulation per Acre**	**Effectiveness**	**REI**	**PHI**	**Comments**
Powdery mildew only (continued)	flutriafol (Rhyme)	5 to 7 fl oz	E^{R}	12 hr	0 days	Rhyme is registered for control of powdery mildew and for drip application to manage charcoal rot. Do not apply more than 4 applications per year. Do not apply more than 28 fl oz of product per acre per year. **FRAC 3.**
	quinoxyfen (Quintec)	4 to 6 fl oz	E	12 hr	1 day	Do not use more than 4 times per crop and no more than 2 times in a row before switching to a product with a different mode of action. Rotate with other mildewcides. Do not apply more than 24 fl oz of product per acre per crop. See label for additional restrictions. **FRAC 13.**
	flutianil (Gatten)	6.0 to 8.0 fl oz	E	12 hr	0 days	Do not apply more than 5 applications per year. Do not apply more than 0.132 lb flutianil per acre per year. Crop can be harvested after product has dried. **Gatten is not registered for use in all states; check state registration status prior to use. FRAC U13.**
	difenoconazole + cyprodinil (Inspire Super)	16.0 to 20.0 fl oz	E	12 hr	0 days	No more than 2 sequential applications should be made before alternating with fungicides that have a different mode of action. Do not apply more than 80 fl oz of Inspire Super per acre per year. Do not apply more than 0.46 lb of difenoconazole per acre per year. Do not apply more than 1.3 lb of cyprodinil per acre per year. **FRAC 3 + 9.**
	Mefentriflucon-azole (Cevya)	5 fl oz	E*	12 hr	0 days	Do not apply more than 3 applications per year. Do not apply more than 15 fl oz of Cevya per acre per year. Do not apply more than 0.39 lb of mefentrifluconazole per acre per year. *Efficacy rating is based on the performance of product in other crops. **FRAC 3.**
	cyflufenamid (Torino)	3.4 oz	VG	4 hr	0 days	Do not make more than 2 applications per year. Do not apply more than 6.8 oz of product per acre per calendar year. Do not apply more than once every 14 days. **FRAC U06.**
	propiconazole (Tilt) [*other products available*]	4 fl oz *See labels*	VG^{R}	24 hr *See labels*	0 days *See labels*	No more than 2 sequential applications should be made before alternating with fungicides that have a different mode of action. Do not apply more than 16 fl oz of Tilt per acre per year. Do not apply more than 4 applications of Tilt per year. Do not apply more than 0.45 lb of propiconazole per acre per year. See other product labels for product specific limits. **FRAC 3.**

Planting and Early Post-planting: Disease Management						
Pest/Problem	**Management Options**	**Amount of Formulation per Acre**	**Effectiveness**	**REI**	**PHI**	**Comments**
Powdery mildew only (continued)	fluopyram + difenoconazole (Luna Flex)	12.0 to 13.6 fl oz	G*	12 hr	0 days	No more than 2 sequential applications or product or of FRAC 7-containing products should be made before alternating with fungicides that have a different mode of action. Do not apply more than 2 applications per year. Do not apply more than 27.2 fl oz of Luna Flex per acre per year. Do not apply more than 0.446 lb of fluopyram per acre per year. Do not apply more than 0.46 lb of difenoconazole per acre per year. *Efficacy rating is based on laboratory data and/or the performance of other similar products. **FRAC 7 + 3.**
	sulfur (various products and formulations)	*See labels*	G	*See labels*	*See labels*	Some products may be **OMRI-listed**. Spray as needed. Avoid using in middle of a hot sunny day that may cause leaf burning. See label for additional restrictions. **FRAC M02.**
Anthracnose crown and fruit rot	Anthracnose crown rot (ACR) and anthracnose fruit rot (AFR) primarily come in with transplants. Inspect plants on arrival and scout after establishment. If present, anthracnose on plants can cause petiole lesions (black sunken areas), stunting, and plant death. **Captan and thiram are recommended for preventative fungicide applications at this time in the season. If anthracnose is confirmed on plants,** see "Early Bloom (10%) and into Harvest" for more effective fungicide recommendations. ****** SEE RESISTANCE MANAGEMENT RECOMMENDATIONS ON PAGES 30 AND 49 for additional details.******					
	captan (various products and formulations)	*See labels*	G	*See labels*	*See labels*	See product labels for product and/or actitve ingredient season limits. In plantings known to be infected with the anthracnose crown rot pathogen, consider applying captan plus thiophanate-methyl (FRAC 1) at 10- to 14-day intervals for a total of 2 to 3 applications in the fall. **FRAC M04.**
	thiram (Thiram SC)	2.0 to 2.5 qt	F	24 hr	1 day	Thiram is a broad-spectrum fungicide similar to captan. Do not apply more than 5 applications (12.4 qt product) per year west of the Mississippi River or more than 12 applications per year (29.7 qt product) east of the Mississippi River. See label for active ingredient limits per acre per year and for other restrictions. **FRAC M03.**
	****** SEE RESISTANCE MANAGEMENT RECOMMENDATIONS ON PAGES 30 AND 49.******					

Planting and Early Post-planting: Disease Management						
Pest/Problem	**Management Options**	**Amount of Formulation per Acre**	**Effectiveness**	**REI**	**PHI**	**Comments**
Neopestalotiopsis diseases	**Neopestalotiopsis fruit/crown rot and leaf spot**, caused by *Neopestalotiopsis* species, was first reported to cause damage in strawberry fields in Florida in 2019 and 2020. This disease has since been observed in most southeastern states. There has been a strong anecdotal association with long periods of rainfall and spider mite infestations. Growers should be diligent and on the lookout for unusually severe leaf spotting/scorching symptoms, though crown infections are not always associated with spots on leaves and fruit. Crown rot symptoms can be similar to those of Phytophthora root rot or anthracnose crown rot. Below-ground symptoms are characterized by darkening of the roots and orange-brown necrosis in the crowns, which contribute to stunting or poor establishment after transplanting. Above-ground symptoms range from stunting to wilting, reddening and necrosis of older leaves, and eventual collapse and death. Fruit rot symptoms are similar to those of anthracnose, whereas leaf spot symptoms mimic other common leaf spots on strawberry caused by *Phomopsis* or *Gnomonia*; therefore, microscopic examination of spores is generally required for confirmation. Current management options are limited and summarized as follows: (1) bring in disease-free transplants; (2) avoid planting varieties that are highly susceptible; (3) limit field operations, such as harvesting and spraying, when plants are wet; (4) sanitize hands, shoes, and clothing when moving out of infected fields; (5) clean and disinfect equipment when moving out of infected fields; (6) remove and destroy symptomatic plants (including crowns and roots) to reduce inoculum and disease spread; and (7) incorporate "efficacious" fungicides (Switch, Thiram, Rhyme, Tilt, Inspire) into the spray program. After harvest is complete, make sure that fields are thoroughly harrowed to break up the remaining strawberry crowns. Following harvest, rotation for two years with other crops would be ideal, allowing survival structures to break down and die. Pre-plant fumigation is recommended and helpful in order to reduce inoculum levels, but it will not control the disease fully from year to year. Use of both Vapam and PicClor 60 may broaden the efficacy of fumigation against fungal pathogens. Laboratories that test for aggressive strains of Neopestalotiopsis species: • Clemson University Molecular Pathogen & Pest Detection Lab: https://www.clemson.edu/public/regulatory/plant-problem/mppd-lab/index.html • University of Florida Gulf Coast Research and Education Center Plant Clinic: https://gcrec.ifas.ufl.edu/plant-clinic/ • Universisty of Georgia Plant Molecular Diagnostic Laboratory: https://site.caes.uga.edu/mdl/					
	thiram (Thiram SC)	2.0 – 2.5 qt	G	24 hr	1 day	Thiram is a broad-spectrum fungicide similar to captan. Do not apply more than 5 applications (12.4 qt product) per year west of the Mississippi River or more than 12 applications per year (29.7 qt product) east of the Mississippi River. See label for active ingredient limits per acre per year and for other restrictions. **Thiram SC has a section 2(ee) Recommendation for use against *Neopestalotiopsis* diseases in many states within the Southeast.** Check the label and check with your state regulatory agency or local Extension agents or experts to determine if your state is covered under the 2(ee) Recommendation. **FRAC M03.**

Planting and Early Post-planting: Disease Management						
Pest/Problem	**Management Options**	**Amount of Formulation per Acre**	**Effectiveness**	**REI**	**PHI**	**Comments**
Neopestalotiopsis diseases (continued)	cyprodinil + fludioxonil (Switch 62.5WG)	14 oz	G	12 hr	0 days	Do not apply more than 56 oz of product per acre per year. Do not apply more than 1.3 lb of cyprodinil per acre per year. Do not apply more than 0.9 lb of fludioxonil per acre per year. **Switch has a section 2(ee) Recommendation for use against *Neopestalotiopsis* diseases in many states within the Southeast.** Check the label and check with your state regulatory agency or local Extension agents or experts to determine if your state is covered under the 2(ee) Recommendation. **FRAC 9 + 12.**
	difenoconazole (Inspire)	*See comments*	F	12 hr	0 days	*Inspire is not labeled for use against *Neopestalotiopsis* diseases; however, when used for management of other diseases, it has been shown to suppress *Neopestalotiopsis*.* **Inspire is not registered for use in all states; check state registration status prior to use. FRAC 3.**
	flutriafol (Rhyme)	*See comments*	F	12 hr	0 days	*Rhyme is not labeled for use against *Neopestalotiopsis* diseases; however, when used for management of other diseases, it has been shown to suppress *Neopestalotiopsis*.* **FRAC 3.**
	propiconazole (Tilt)	*See comments*	F	24 hr	0 days	*Tilt is not labeled for use against *Neopestalotiopsis* diseases; however, when used for management of other diseases, it has been shown to suppress *Neopestalotiopsis*.* **FRAC 3.**

Post-planting: Arthropod Management						
Pest/Problem	**Management Options**	**Amount of Formulation per Acre**	**Effectiveness**	**REI**	**PHI**	**Comments**
Crickets	Crickets are an infrequent problem in strawberries and rarely require management.					
	carbaryl (Sevin 4F) (Sevin XLR)	 1 to 2 qt 1 to 2 qt	G	 12 hr 12 hr	 7 days 7 days	Repeated use of carbaryl may flare spider mite populations. DO NOT apply when bees are foraging. **IRAC 1A.**
	malathion (Malathion 57 EC) (Malathion 8 Flowable) [*other products available*]	 1.5 to 3 pt 1.5 to 2 pt *See labels*	F	 12 hr 12 hr *See labels*	 3 days 3 days *See labels*	Apply when damage is first noted. DO NOT apply when bees are foraging. **IRAC 1B.**
Cutworms	Cutworms are usually more of a problem in matted-row culture or weedy plantings. Scout for cutworm damage and presence after transplant. Early morning is best for scouting.					
	chlorantraniliprole (Coragen eVo)	 1.2 to 2.5 fl oz	E	 4 hr	 1 day	*Coragen is not labeled for use against cutworms; however, when used for management of other insects, it has been shown to have efficacy against cutwoms.* **IRAC 28.**
	methoxyfenozide (Intrepid 2F)	 6 to 12 fl oz	VG	 4 hr	 3 days	**IRAC 18.**
	spinosad (Entrust 80W) (Entrust SC)	 1.25 to 2 oz 4 to 6 fl oz	VG	 4 hr 4 hr	 1 day 1 day	*Entrust is not labeled for use against cutworms; however, when used for management of other insects, it has been shown to have efficacy against cutwoms.* **OMRI**-listed. Rotate to a different class of insect control products after 2 successive applications of spinosad. See product labels for season limits and additional restrictions. **IRAC 5.**
	Bacillus thuringiensis (Bt) (various products)	 *See labels*	G	 *See labels*	 *See labels*	Many Bt formulations are **OMRI**-listed. Bt insecticides have a short residual. Heavy infestations may need repeated applications. Applications are more effective against young larvae. **IRAC 11B.**
	carbaryl (Sevin 4F) (Sevin 4 XLR)	 1 to 2 qt 1 to 2 qt	G	 12 hr 12 hr	 7 days 7 days	Repeated use of carbaryl can cause spider mite problems. Apply late in the day when plants clipped at the base are first noticed. DO NOT apply when bees are foraging. **IRAC 1A.**
	Malathion (Malathion 57 EC) (Malathion 8 Flowable)	 1.5 to 3 pt 1.5 to 2 pt	G	 12 hr 12 hr	 3 days 3 days	Malathion 8 Flowable can be applied via drip lines, allowing treatment under plastic if cutworms are present. **IRAC 1B.**

Post-planting: Arthropod Management						
Pest/Problem	**Management Options**	**Amount of Formulation per Acre**	**Effectiveness**	**REI**	**PHI**	**Comments**
Cyclamen mite	Cyclamen mites are often present near the crown of the plant and can be hard to reach with spray applications. Sufficient water must be used to obtain good coverage for product efficacy. Large water volumes are often needed, particularly when plants are big; 200 to 250 gallons per acre is preferred. To achieve the best efficacy, listed products should be mixed with a non-ionic type of wetting/spreading/penetrating adjuvant.					
	abamectin (Agri-Mek SC)	3.5 fl oz	VG	12 hr	3 days	*Labeled for suppression only.* Do not use a binder sticker type adjuvant. **IRAC 6.**
	fenpyroximate (Portal)	2 pt	ND	12 hr	1 day	Limited data on Portal is available in the Southeast. **IRAC 21A.**
	fenazaquin (Magister SC)	32 to 36 fl oz	ND	12 hr	1 day	There is limited data on cyclamen mite control in strawberries. It will kill eggs and mobile mite stages by contact and ingestion IF the mites are reached in young leaves near the crown. Do not make more than one application per year. This product is toxic to bees. Do not apply this product until crop is through petal fall unless the conditions for bee protection mentioned in the label are met. Read the bee-protection language on the label carefully. **IRAC 21A.**
Strawberry clipper	All common plasticulture varieties and many matted row varieties compensate for bud loss due to strawberry clipper injury, and clippers do not typically justify treatment. Materials effective against clippers are also toxic to honey bees.					
	bifenthrin (Brigade eVo)	2.56 to 12.8 oz	VG	12 hr	0 days	***Restricted use pesticide (RUP).*** DO NOT apply when bees are foraging. **IRAC 3.**
	fenpropathrin (Danitol 2.4 EC)	16 to 21.33 fl oz	VG	24 hr	2 days	***Restricted use pesticide (RUP).*** DO NOT make more than 2 applications per crop per season. Apply in at least 100 gal of water per acre. DO NOT apply when bees are foraging. **IRAC 3A.**
	carbaryl (Sevin XLR) (Sevin 4F)	 1 to 2 qt 1 to 2 qt	G	 12 hr 12 hr	 7 days 7 days	Apply material at dusk when bees are not foraging and allow the maximum amount of dry time before bees become active. *Note:* Sevin XLR and 4F have a lower impact on bees than other carbaryl products. **IRAC 1A.**

Post-planting: Arthropod Management						
Pest/Problem	**Management Options**	**Amount of Formulation per Acre**	**Effectiveness**	**REI**	**PHI**	**Comments**
Twospotted spider mite	Check with local Cooperative Extension specialists to determine twospotted spider mite treatment thresholds in your area.					
	Predatory mites (*Phytoseiulus persimilis, Neoseiulus fallacis*, *N. californicus*, and others)	Release rates vary based upon predatory species and prey density	Importance: Very important Effectiveness: VG	N/A	N/A	In general, release 2 to 3 mites per plant when mite populations are low and 5 predators per plant when populations are high. Predatory mite releases must be initiated at or before twospotted spider mites reach threshold levels (5 mites per leaflet), and spider mite populations must be followed closely after predatory mite releases because they may vary in efficacy. Consult supplier for best implementation practices as species differ in attributes, and delays in observable reduction of spider mites may be observed. Predatory mites may be affected by broad-spectrum insecticides; multiple releases may be required. For more information, see the *Small Fruit News* article "Twospotted spider mite and integration of biocontrol."
	acequinocyl (Kanemite 15 SC)	21 to 31 fl oz	E	12 hr	1 day	Allow 21 days between treatments. Do not make more than 2 applications per season. Use in a minimum of 100 gal/acre. **IRAC 20B.**
	bifenazate (Acramite 50WS) (Vigilant 4SC)	0.75 to 1 lb 12 to 16 fl oz	E*	12 hr 12 hr	1 day 1 day	Allow 21 days between treatments. Do not make more than 2 applications per crop cycle. Do not make more than 4 applications per year. Use in a minimum of 100 gal/acre. *Efficacy rating of Vigilant is based on the performance of Acramite. **IRAC 20D.**
	cyflumetofen (Nealta)	13.7 fl oz	E	12 hr	1 day	Use only 2 applications per year. Use in a minimum of 50 gal/acre. Allow 14 days between applications. Use an effective miticide with a different mode of action between applications. **IRAC 25.**
	spiromesifen (Oberon 2 SC)	16 fl oz	E	12 hr	3 days	Make no more than 1 application per year. Use in a minimum of 100 gal/acre. **IRAC 23.**
	abamectin (Agri-Mek SC)	3.5 fl oz	VG	12 hr	3 days	Make 2 applications 7 to 10 days apart when mites first appear. Do not exceed 64 fl oz per acre in a growing season. Apply in a minimum of 100 gal of water per acre. Do not repeat treatment within 21 days of second application. For resistance management, do not use in strawberry nurseries. **IRAC 6.**

Post-planting: Arthropod Management						
Pest/Problem	**Management Options**	**Amount of Formulation per Acre**	**Effectiveness**	**REI**	**PHI**	**Comments**
Twospotted spider mite (continued)	etoxazole (Zeal)	2 to 3 oz	VG	12 hr	1 day	Make only 1 application per season. DO NOT apply more than 3 oz per acre per crop. Use in a minimum of 100 gal/acre. **IRAC 10B.**
	fenazaquin (Magister)	32 to 36 fl oz	VG	12 hr	1 day	Make only 1 application per year. Apply in at least 50 gal of water per acre. Product is effective against all stages. Product is very toxic to bees. **IRAC 21A.**
	fenpyroximate (Portal)	2 pt	VG	12 hr	1 day	Do not make more than 2 applications per crop cycle. Allow 14 days between applications. Use in a minimum of 25 gal/acre. **IRAC 21A.**
	hexythiazox (Savey 50 DF)	6 oz	VG	12 hr	3 days	Controls eggs and immature mites but not adults. Use only once. DO NOT apply more than 6 oz per crop, 1 application per year. DO NOT use in strawberry nurseries. If many adult mites are present, use a material effective on adult mites, such as Agri-Mek. **IRAC 10A.**
	horticultural oils (JMS Stylet Oil) (Organic JMS Stylet Oil) (Omni Supreme Spray) [*other products available*]	 3 qt per 100 gal 3 qt per 100 gal 1 to 2% by volume in 200 gal *See labels*	G	 4 hr 4 hr 12 hr *See labels*	 0 days 0 days 0 days *See labels*	Organic JMS Stylet Oil is **OMRI-**listed. Oils should not be applied 48 hours or less before freezing temperature, at temperatures over 90°F, or to water-stressed plants. Use sufficient water to achieve coverage; a volume of 100 to 200 gal per acre is recommended. For best results begin use with low mite populations. Because oils lack the residual activity of conventional insecticides, they may need to be applied repeatedly to control mites.
	insecticidal soap (M-Pede)	1 to 2 gal per 100 gal	F	12 hr	0 days	Thorough coverage is needed. Plant damage has been noted under particularly cold or hot conditions. For best results begin use with low mite populations.
	rosemary, geraniol, and peppermint oils (Ecotec Plus) (Ecotrol Plus)	 1 to 4 pt per 100 gal (2 to 6 fl oz per 10 gal) 1 to 4 pt per 100 gal	F	 0 hr 0 hr	 0 days 0 days	Ecotec and Ecotrol are **OMRI-**listed. Because oils lack the residual activity of conventional insecticides, they may need to be applied repeatedly for control. Plant damage has been noted for some oils under some weather conditions.
	sucrose octanoate (SucraShield)	0.8 to 1.0 % v/v	F	48 hr	0 days	**OMRI-**listed. Data for SucraShield against twospotted spider mites are limited. Apply in a volume of 100 to 200 gal per acre.

New Leaf Growth to Pre-bloom: Disease Management						
Pest/Problem	**Management Options**	**Amount of Formulation per Acre**	**Effectiveness**	**REI**	**PHI**	**Comments**
CAUTION: Some fungicides may negatively impact bees during bloom. When possible, apply all necessary bloom period treatments at dusk, when bees are not foraging, and allow for the maximum dry time possible between application and when foraging resumes.						
Anthracnose crown rot and fruit rot	**ACR and AFR** primarily come in with transplants. Scouting plants after establishment is recommended. If present, anthracnose on plants can cause petiole lesions (black sunken areas), stunting, and plant death. **Captan and thiram are recommended for preventative fungicide applications at this time in the season. If anthracnose is confirmed on plants,** see "Early Bloom (10%) and into Harvest" for more effective fungicide recommendations. ****** SEE RESISTANCE MANAGEMENT RECOMMENDATIONS ON PAGES 34 AND 53 for additional details.****** captan (various products and formulations) — *See labels* — G — *See labels* — *See labels* — See product labels for product and/or active ingredient season limits. In plantings known to be infected with the anthracnose crown rot pathogen, consider applying captan plus thiophanate-methyl (FRAC 1) at 10- to 14-day intervals for a total of 2 to 3 applications in the fall. **FRAC M04.** thiram (Thiram SC) — 2.0 to 2.5 qt — F — 24 hr — 1 day — Thiram is a broad-spectrum fungicide similar to captan. Do not apply more than 5 applications (12.4 qt product) per year west of the Mississippi River or more than 12 applications per year (29.7 qt product) east of the Mississippi River. See label for active ingredient limits per acre per year and for other restrictions. **FRAC M03.** ****** SEE RESISTANCE MANAGEMENT RECOMMENDATIONS ON PAGES 34 AND 53.******						
Botrytis crown rot	**Botrytis crown rot** may occur during warm winter periods after early bloom is killed by frost and colonized by *Botrytis*. The pathogen typically grows down the flower stem (peduncle) and colonizes the upper crown tissue, causing death of the leaf petioles, particularly if plants are large or planted densely. ***Note: Do not use QoI fungicides from new leaf growth to pre-bloom; these should be saved for use as fruit develop and to avoid selection of resistant populations.*** ****** SEE RESISTANCE MANAGEMENT RECOMMENDATIONS ON PAGES 34 AND 53.****** iprodione (Rovral 4F) — (foliar spray) 1.5 to 2 pt (alone) 1.0 pt (tank-mix) — VG — 24 hr — See comments — Do not apply after first fruiting flower. Do not make more than one application of product per season. Do not apply more than 2 pt of product per acre per season (stand-alone) or 1 pt of product per acre per season (tank-mix). Crown rot control during the early winter and prior to bloom may be the most effective use of the one Rovral application allowed in strawberries. **FRAC 2.** captan (various products and formulations) — *See labels* — F — *See labels* — *See labels* — See product labels for product and/or active ingredient season limits. **FRAC M04.** ****** SEE RESISTANCE MANAGEMENT RECOMMENDATIONS ON PAGES 34 AND 53.******						

New Leaf Growth to Pre-bloom: Disease Management						
Pest/Problem	**Management Options**	**Amount of Formulation per Acre**	**Effectiveness**	**REI**	**PHI**	**Comments**
CAUTION: Some fungicides may negatively impact bees during bloom. When possible, apply all necessary bloom period treatments at dusk, when bees are not foraging, and allow for the maximum dry time possible between application and when foraging resumes.						
Botrytis crown rot (continued)	****** SEE RESISTANCE MANAGEMENT RECOMMENDATIONS ON PAGES 34 AND 53.******					
	thiram (Thiram SC)	1.5 to 2.5 qt	F	24 hr	1 day	Thiram is a broad-spectrum fungicide similar to captan. Do not apply more than 5 applications (12.4 qt product) per year west of the Mississippi River or more than 12 applications per year (29.7 qt product) east of the Mississippi River. See label for active ingredient limits per acre per year and for other restrictions. **FRAC M03.**
Botrytis crown rot and fruit rot	****** SEE RESISTANCE MANAGEMENT RECOMMENDATIONS ON PAGES 34 AND 53.******					
	Remove dead and dying leaves just before bloom	N/A	Importance: F Efficacy: G	N/A	N/A	Symptomatic leaf removal is effective but may not be economical if fungicides are heavily used for Botrytis management. If anthracnose fruit rot is present, hand-pruning plants may create more anthracnose disease problems.
Neopestalotiopsis diseases	See the **Planting and Early Post-planting: Disease Management** recommendations.					
Common leaf spot, leaf scorch, leaf blight (e.g., *Mycosphaerella*, *Phomopsis*, *Gnomonia*)	**Leaf spots, leaf blights, and powdery mildew** generally do not become economically important diseases in the fall or early spring. Thus, fungicides are generally not required for these problems. Thresholds have not been established, so the need for fungicides should be determined on a farm-by-farm basis depending on the disease pressure present. These diseases may be associated with plant sources; therefore, disease incidence can vary from year to year. Warm, wet weather favors disease progress. In the spring, monitor fields closely observing the underside of strawberry leaves to determine if powdery mildew is present. See previous notes on powdery mildew on pages 34. FRAC 11 products or mixtures with FRAC 11 fungicides are labeled but not listed to manage powdery mildew and leaf spots in order to optimize FRAC 11 fungicide use for anthracnose fruit rot management.					
	myclobutanil (Rally 40WSP)	2.5 to 5 oz	VG	24 hr	1 day	Rally is registered for control of leaf spot, leaf blight, and powdery mildew. Do not apply more than 30 oz of product per acre per year. **FRAC 3.**
	captan (various products and formulations) + thiophanate-methyl (Topsin M WSB) [*other products available*]	*See labels* 0.75 to 1 lb *See labels*	G	*See labels* 24 hr *See labels*	*See labels* 1 day *See labels*	When foliar symptoms appear, make 1 or 2 captan applications plus thiophanate-methyl (FRAC 1) at a 10- to 14-day interval for better control than captan products alone would provide. See product labels for product and/or actitve ingredient season limits. Do not tank mix captan products with highly alkaline pesticides, such as Bordeaux mixture. ***See resistance management notes on page 34.*** **FRAC M04 + FRAC 1.**

New Leaf Growth to Pre-bloom: Disease Management						
Pest/Problem	**Management Options**	**Amount of Formulation per Acre**	**Effectiveness**	**REI**	**PHI**	**Comments**
CAUTION: Some fungicides may negatively impact bees during bloom. When possible, apply all necessary bloom period treatments at dusk, when bees are not foraging, and allow for the maximum dry time possible between application and when foraging resumes.						
Common leaf spot, leaf scorch, leaf blight (continued)	captan (various products and formulations)	*See labels*	F	*See labels*	*See labels*	See product labels for product and/or actitve ingredient season limits. Do not tank mix captan products with highly alkaline pesticides, such as Bordeaux mixture. ***See resistance management notes on page 30.*** **FRAC M04.**
Powdery mildew only	See the **Planting and Early Post-planting: Disease Management** recommendations.					
Angular (bacterial) leaf spot (*Xanthomonas fragariae*)	**Angular leaf spot**, caused by the bacterium *Xanthomonas fragariae*, can cause leaf and calyx damage. Though significant, yield-limiting leaf damage is relatively rare, calyx damage is an aesthetic issue that can negatively impact sales. Therefore, angular leaf spot should be managed in southeastern strawberry production. Contaminated transplants are known to be a primary source of the pathogen, though bacteria can survive in leaf litter in the field for at least a year. Generally, warm, moist conditions (rain or overhead irrigation) followed by cool to cold nights (frost and freeze damage) and blowing sand (cutting the leaves and calyx) will increase disease levels. Ice from overhead freeze protection has also been associated with increased angular leaf spot, presumably from tissue damage and bacterial entry. The bacterium can be suppressed by use of preventive copper sprays (primarily copper hydroxide or copper sulfate products). Though copper use has been proven to be generally safe on strawberries, discontinue use if phytotoxicity occurs. Florida trials have shown that preventive, weekly applications of copper fungicides at 0.3 lb of metallic copper per acre are efficacious, without causing phytotoxicity. Under poor drying conditions and when applied with acidic materials, more pronounced copper damage has been reported. Actigard, also when applied preventatively and at low rates, can likewise suppress disease without reducing yields.					
	copper (basic copper sulfate, copper hydroxide, copper salts of fatty and rosin acids, cuprous oxide) (various products and formulations)	*See labels*	P	*See labels*	*See labels*	Angular (bacterial) leaf spot can be a serious problem during cool, wet conditions. These compounds provide some control unless conditions highly favor disease. Repeat applications at 7- to 10-day intervals. Discontinue when phytotoxicity appears, usually after 4 to 5 applications. Check product labels to be sure that products are labeled for use on strawberry. Individual products have various percentages of active ingredient. Follow all instructions on the specific product label. **FRAC M01.**
	acibenzolar-S-methyl (Actigard 50WG)	0.5 to 0.75 oz	P	12 hr	0 days	*For suppression*. Do not apply within 5 days of transplanting. Do not apply to stressed plants. Do not apply more than 6 oz of product per acre per year. Actigard is a plant activator and has no direct activity on the bacteria. **FRAC P01.**

New Leaf Growth to Pre-bloom: Disease Management						
Pest/Problem	**Management Options**	**Amount of Formulation per Acre**	**Effectiveness**	**REI**	**PHI**	**Comments**
CAUTION: Some fungicides may negatively impact bees during bloom. When possible, apply all necessary bloom period treatments at dusk, when bees are not foraging, and allow for the maximum dry time possible between application and when foraging resumes.						
Red stele; Phytophthora crown/root rots	mefenoxam (ReCon Bold SL) (Ridomil Gold SL) (Thrive 4M) (Ultra Flourish)	 1 pt 1 pt 15.7 fl oz 2 pt	VG	 See label See label See label See label	 0 days 0 days 0 days 0 days	Strawberry plants initiate considerable root growth in early spring. Time control applications in problem fields when new growth begins in the spring. Apply in sufficient water to move the fungicide into the root zone. ****See labels for instructions regarding rates to be used in drip and band applications.**** REI varies and is dependent upon method of application. **FRAC 4.** See labels for limits of mefenoxam containing products per crop. **ReCon Bold SL:** Do not exceed 3 pt per acre per year or 3 applications per crop. **Ridomil Gold SL:** Do not exceed 3 applications per crop. **Thrive 4M:** Do not exceed 3 applications per acre per year at reduced rate. **Ultra Flourish:** Do not exceed 6 pt per acre per year.
	metalaxyl (ReCon 4 F)	1 qt	VG	See label	See label	Apply in sufficient water in drip applications to move the fungicide into the root zone**. **See labels for instructions regarding rates to be used in drip and band applications.**** REI varies and is dependent upon method of application. Do not exceed 3 qt of product per treated acre per year. **FRAC 4.**
	oxathiapiprolin + mefenoxam (Orondis Gold)	20.0 to 62.0 fl oz/A	VG	See label	14 days	Product should be applied through drip application. Do not apply more than two sequential applications before switching to a product with a different mode of action. Do not apply more than 2 applications per year at the maximum rate. *In new plantings*, the first application should be made soon after planting and the second application should be made 30 days before the beginning or harvest or at fruit set. *In established plantings*, the first application should be made in the spring before first bloom and the second application should be made after harvest. See label for other restrictions and limits. **FRAC 49 + 4.**

New Leaf Growth to Pre-bloom: Disease Management						
Pest/Problem	**Management Options**	**Amount of Formulation per Acre**	**Effectiveness**	**REI**	**PHI**	**Comments**
CAUTION: Some fungicides may negatively impact bees during bloom. When possible, apply all necessary bloom period treatments at dusk, when bees are not foraging, and allow for the maximum dry time possible between application and when foraging resumes.						
Red stele; Phytophthora crown/root rots (continued)	phosphites (ProPhyt) (Phostrol) *[other products available]*	(foliar) 2 to 4 pt 2.5 to 5.0 pt *See labels*	F	4 hr 4 hr *See labels*	0 days See label *See labels*	Phosphite-based chemicals are not as effective as Ridomil Gold. Consider phosphites if the pathogen is known to be resistant to mefenoxam or if strawberry plants have poor root systems AND foliage is healthy for chemical uptake. Do not apply more than 30 lb of Aliette WDG per acre per season. **Check the registration status of products prior to use. Not all products are registered for use in all states. Counties in some states, including AR, KY, LA, MS, and NC, have further restrictions for Aliette WDG use.** Check product labels for specific instructions, cautions, and restrictions. **FRAC P07.**
	fosetyl-Al (Aliette WDG)	(foliar) 2.5 to 5.0 lb	F	24 hr	12 hr	

Pre-bloom to Harvest: Arthropod Management						
Pest/Problem	**Management Options**	**Amount of Formulation per Acre**	**Effectiveness**	**REI**	**PHI**	**Comments**
CAUTION: Insecticides may negatively impact bees during bloom. Do not treat unless economically significant populations of insects or mites are present. Apply all necessary bloom period treatments at dusk, when bees are not foraging, and allow for the maximum dry time possible between application and when foraging resumes.						
Aphids	Aphids rarely reach damaging populations in strawberries, and late season populations are often controlled by natural enemies. Aphids should not be treated unless populations exceed 10 per newly expanded leaf and/or excessive sooty mold is present.					
	flupyradifurone (Sivanto 200 SL)	7.0 to 10.5 fl oz	VG	4 hr	0 days	Do not tank mix with azole fungicides (FRAC 3) during bloom period. Apply no more often than every 10 days and no more than 28 fl oz per acre per year. **IRAC 4D.**
	imidacloprid (Admire Pro)	10.5 to 14 fl oz (soil) 1.3 fl oz (foliar)	VG	12 hr	14 days 7 days	Can be applied through drip irrigation or as a foliar spray. DO NOT apply when bees are foraging or within 10 days of bloom. **IRAC 4A.**
	acetamiprid (Assail 30 SG)	1.9 to 4.0 oz	VG	12 hr	1 day	DO NOT make more than 2 applications per calendar year. **IRAC 4A.**
	thiamethoxam (Platinum) (Actara)	5 to 12 fl oz (soil) 1.5 to 3 oz (foliar)	G	12 hr 12 hr	50 days 3 days	DO NOT apply when bees are foraging; after a Platinum or Actara application, WAIT FIVE DAYS before placing beehives into treated fields. **IRAC 4A.** **Platinum:** Do not apply more than 12 fl oz per acre per year. *Note:* The long PHI for Platinum makes it useful only as a post-transplant material. **Actara:** Do not apply more than 12 oz per acre per year. Allow 10 days between applications.
	bifenthrin (Brigade eVo)	2.56 to 12.8 oz	F	12 hr	0 days	The use of broad-spectrum insecticides during bloom will damage honey bee populations. DO NOT apply when bees are foraging. Refer to label. **IRAC 3A.**
	malathion (Malathion 57 EC) [*other products available*]	1.5 pt *See labels*	F	12 hr *See labels*	3 days *See labels*	DO NOT apply when bees are foraging. **IRAC 1B.**
	insecticidal soap (M-Pede)	1 to 2 gal per 100 gal	F	12 hr	0 days	Thorough coverage is needed. Plant damage has been noted under some weather conditions.
Cutworms	See **Post-planting: Arthropod Management** recommendations.					

Pre-bloom to Harvest: Arthropod Management						
Pest/Problem	**Management Options**	**Amount of Formulation per Acre**	**Effectiveness**	**REI**	**PHI**	**Comments**
CAUTION: Insecticides may negatively impact bees during bloom. Do not treat unless economically significant populations of insects or mites are present. Apply all necessary bloom period treatments at dusk, when bees are not foraging, and allow for the maximum dry time possible between application and when foraging resumes.						
Flower thrips	The primary flower thrips species of concern is the western flower thrips (WFT), *Frankliniella occidentalis*, whose feeding causes discoloration ('bronzing') on fruit. WFT look identical to the more common native eastern flower thrips, *F. tritici,* which is not a pest in strawberries and is only found within flowers and not on foliage or fruit. Therefore, accurate identification is critical. Broad-spectrum insecticide use has been shown to eliminate natural enemies and non-pest thrips species to favor the proliferation of WFT. Limited effective insecticides are available so only treat when damaging populations are present, rotate modes of action, and apply in evening when pollinators are not foraging. See the Insect Alert: Chilli Thrips for more information of the damage caused by this invasive pest.					
	cyantraniliprole (Exirel)	13.5 to 20.5 fl oz	VG	12 hr	1 day	Foliage feeding thrips only. Minimum application interval between treatments is 7 days. **IRAC 28.**
	spinetoram (Radiant SC)	6 to 10 fl oz	VG	4 hr	1 day	Spinetoram is highly toxic to pollinators when wet. If treatment is necessary, treat in the evening when bees are not foraging to allow for maximum dry time. **IRAC 5.**
	acetamiprid (Assail 30 SG)	4.0 to 6.9 oz	G	12 hr	1 day	Do not apply when bees are foraging. Assail will not control western flower thrips. **IRAC 4A.**
	spinosad (Entrust 80W) (Entrust SC)	1.25 to 2 oz 4 to 6 fl oz	G	4 hr 4 hr	1 day 1 day	Entrust is **OMRI**-listed. Rotate to a different class of insecticide after 2 successive applications. See product labels for season limits and additional restrictions. Spinosad is highly toxic to pollinators when wet. If treatment is necessary, treat in the evening when bees are not foraging to allow for maximum dry time. **IRAC 5.**
	novaluron (Rimon 0.83EC)	6 to 12 fl oz	F	12 hr	1 day	Novaluron is an insect growth regulator (IGR) that disrupts insect cuticle formation. It does not kill thrips outright but prevents immatures from developing. Novaluron is not effective against adult thrips. **IRAC 15.**

Pre-bloom to Harvest: Arthropod Management						
Pest/Problem	**Management Options**	**Amount of Formulation per Acre**	**Effectiveness**	**REI**	**PHI**	**Comments**
CAUTION: Insecticides may negatively impact bees during bloom. Do not treat unless economically significant populations of insects or mites are present. Apply all necessary bloom period treatments at dusk, when bees are not foraging, and allow for the maximum dry time possible between application and when foraging resumes.						
Imported fire ants	Ensure that ants are actively foraging before applying baits.					
	pyriproxyfen (Esteem Ant Bait 0.5% B)	1.5 to 2 lb	VG	12 hr	1 day	Esteem Ant Bait is an insect growth regulator (IGR) and acts on the reproductive activity of the queen(s). Apply when ants are actively foraging. Apply during dry weather; do not water for 24 hours after application. See label for individual mound treatment instructions. **IRAC 7C.**
	methoprene (Extinguish Professional Fire Ant Bait 0.5 % B)	0.75 lb (broadcast)	VG	4 hr	0 days	Extinguish is an IGR and acts on the reproductive activity of the queen(s). Allow at least 3 weeks to see reduction in mound activity and 8 to 10 weeks for mound elimination. Extinguish can be applied as a broadcast or individual mound treatment. See label for instructions for treatment of individual mounds. **IRAC 7A.**
Slugs and snails	iron phosphate (Sluggo Snail and Slug Bait) [*other products available*]	20 to 44 lb *See labels*	G	0 hr *See labels*	0 days *See labels*	Some products are **OMRI-**listed. Apply in the evening.
	metaldehyde (Deadline Bullets) (Deadline M-Ps) [*other products available*]	See label See label *See labels*	G	12 hr 12 hr *See labels*	0 days 0 days *See labels*	**Metaldehyde is a systemic toxin. There is no antidote. Application of this product is prohibited unless children and domestic animals can be excluded from the treated area from the start of the application until applied material is no longer visible. **SEE LABELS FOR PRECAUTIONS AND DIRECTIONS FOR USE.**** Apply products as a soil surface treatment. Use a band treatment between plant rows. A maximum of three applications are allowed per season. **This is a molluscicide (no IRAC code).**
Strawberry clipper	See **Post-Planting: Arthropod Management** recommendations.					
Twospotted spider mite	See **Post-Planting: Arthropod Management** recommendations.					

Early Bloom (10%) and into Harvest: Disease Management

The primary diseases of concern at early bloom and into harvest are **Botrytis fruit rot** (BFR) and **anthracnose fruit rot (AFR)**. Several **key principles** should be kept in mind:

1. Quadris, Cabrio, Merivon, Pristine, Luna Sensation, and some others belong to the same family of chemicals (QoIs; FRAC 11). Pyraclostrobin (Cabrio, Merivon, and Pristine) has offered better control of AFR in recent research efforts. ***No more than two applications of a FRAC 11 fungicide should be made per season for resistance management.*** Strategic timing is necessary. Pristine, Luna Sensation, and Merivon also have a second chemical that has good broad-spectrum activity against several diseases, especially those caused by *Botrytis*. QoI resistance has been found in 'acutatum' populations in the south. The problem tends to be plant-source-associated.
2. Captan (FRAC M04), thiram (FRAC M03), and Switch (FRAC 9+12) offer a broad spectrum of disease control. Switch had modest efficacy against AFR in NC research.
3. Polyoxin D zinc salt (FRAC 19; Ph-D and OSO 5%SC) at high label rates is as effective as captan for *Botrytis* and can help reduce reliance on fungicides that have resistance concerns.
4. ***Elevate should not be used more than twice per season due to resistance concerns.*** It is effective against *Botrytis* but no other fungal pathogens.
5. ***With exception of thiram and captan, fungicides of the same chemical class (FRAC group) should not be applied in consecutive applications.***
6. Bloom sprays are the most important for managing *Botrytis*, because 90% of fruit infection occurs through the flower at bloom. Recent research suggests bloom sprays are also critical for AFR control.
7. Fruit rot diseases develop rapidly during wet periods or in poorly ventilated locations. Control is easier when initiated before the problem develops. Spray coverage is important and dependent on nozzle condition, tractor speed, pressure, and plant density. Spray coverage can be checked with water sensitive cards.

Fungicide Selection for Botrytis and Anthracnose Fruit Rot Management

Management of Botrytis fruit rot (**BFR**) and anthracnose fruit rot (**AFR**) caused by *Colletotrichum* species has become more complex. Growers need to use products that work against resistant strains of BFR and manage AFR at the same time. In general, we recommend using thiram (FRAC M03) and captan (FRAC M04) as a backbone for spray programs. Use them as solo products during low disease pressure situations and add a more potent fungicide from FRAC groups 2, 7, 9, 12, 17, or 19 to the rotation when infection pressure increases.

Use members of any FRAC group (except M03 or M04) no more than twice per season. (For example, if Fontelis and Merivon were each used once, the 2 applications for FRAC 7 fungicides have been maxed out.)

Resistance to FRAC 11 fungicides (e.g., Quadris, Cabrio, Luna Sensation, Merivon, Pristine) in the *Colletotrichum* pathogens causing AFR has been found in Florida, North Carolina, South Carolina, and California; problems tend to be plant-source associated. Therefore, it is a good idea to use the FRAC 11 fungicides only in a mixture at the lower labeled rate with the higher labeled rate of a captan product alternated with captan alone. Reduced activity with azoxystrobin (e.g., Quadris, etc.; FRAC 11) with certain strains of the AFR pathogen has also been documented. Cabrio (FRAC 11) and FRAC 7 + 11 products have offered better control of AFR in recent research efforts and if strains are not resistant to FRAC 11 fungicides.

It is strongly recommend that producers use a fee-based service, provided by the Clemson University Plant and Pest Diagnostic Clinic https://www.clemson.edu/public/regulatory/plant-problem/mppd.html or the UGA Plant Disease Clinic https://site.caes.uga.edu/mdl/instructions-for-sample-collection-and-submisson/, to determine effective and ineffective FRAC codes against BFR and AFR.

Consult the rest of this guide for additional information on total IPM Programs and download the MyIPM app to learn more about disease/pest management and FRAC codes. Also, consult the Diagnosis Tool (https://diagnosis.ces.ncsu.edu/strawberry/) and Strawberry Disease Factsheets (https://strawberries.ces.ncsu.edu/strawberries-diseases/) for additional information and assistance in identifying strawberry diseases.

Early Bloom (10%) and into Harvest: Disease Management						
Pest/Problem	**Management Options**	**Amount of Formulation per Acre**	**Effectiveness**	**REI**	**PHI**	**Comments**
Botrytis fruit rot	**** SEE RESISTANCE MANAGEMENT RECOMMENDATIONS ON PAGES 30 AND 49.****					
	penthiopyrad (Fontelis)	16 to 24 fl oz	E^R	12 hr	0 days	Do not apply more than 72 fl oz of product per acre per year. Some matted row cultivars may show phytotoxicity (see label). **FRAC 7.**
	isofetamid (Kenja 400SC)	13.5 to 15.5 fl oz	E^R	12 hr	0 days	Do not apply more than 3 applications of product at the high rate or more than 4 applications of product at the low rate per acre per year (54 fl oz per acre per year). Do not apply a third application of product within 28 days of the second application of the product. Some matted row cultivars may show phytotoxicity (see label). **FRAC 7.**
	fluopyram + pyrimethanil (Luna Tranquility)	16 to 27 fl oz	E^R	12 hr	1 day	Do not apply more than 54.7 fl oz of product per acre per year. Do not apply more than 0.446 lb of fluopyram per acre per year. Do not apply more than 2.1 lb of pyrimethanil per acre per year. **Luna Tranquility is not registered for use in LA. FRAC 7 + 9.**
	**** SEE RESISTANCE MANAGEMENT RECOMMENDATIONS ON PAGES 30 AND 49.****					
	fluopyram + trifloxystrobin (Luna Sensation)	6 to 7.6 fl oz	E^R	12 hr	0 day	Do not apply more than 27.1 fl oz of product per acre per year. Do not apply more than 0.446 lb of fluopyram per acre per year. Do not apply more than 0.6 lb of trifloxystrobin per acre per year. **FRAC 7 + 11.**
	cyprodinil + fludioxonil (Switch 62.5WG)	11 to 14 oz	E	12 hr	0 days	Do not apply more than 56 oz of product per acre per year. Do not apply more than 1.3 lb of cyprodinil per acre per year. Do not apply more than 0.9 lb of fludioxonil per acre per year. **FRAC 9 + 12.**
	fenhexamid (Elevate 50 WDG)	1.5 lb (stand-alone) 1.0 to 1.5 lb (tank mix)	E^R	12 hr	0 days	Do not make more than 2 consecutive applications before switching to a fungicide with a different mode of action. Do not apply more than 6.0 lb of product per acre per season. Do not apply more than 3.0 lb of fenhexamid per acre per season. Under light pressure, 1.0 lb Elevate plus captan may be used (see label). With plastic mulch, do not apply within 16 ft of naturally vegetated or aquatic areas. *Note: Due to resistance issues fenhexamid should be applied with a protectant, such as captan (FRAC M04).* **FRAC 17.**
	**** SEE RESISTANCE MANAGEMENT RECOMMENDATIONS ON PAGES 30 AND 49.****					

Early Bloom (10%) and into Harvest: Disease Management						
Pest/Problem	**Management Options**	**Amount of Formulation per Acre**	**Effectiveness**	**REI**	**PHI**	**Comments**
Botrytis fruit rot (continued)	*** SEE RESISTANCE MANAGEMENT RECOMMENDATIONS ON PAGES 30 AND 49.***					
	pydiflumetofen + fludioxonil (Miravis Prime)	9.1 to 13.4 fl oz	E*	12 hr	0 days	Do not make more than 2 consecutive applications of product or of FRAC 7- or FRAC 12-containing products. Do not make more than 2 applications at the maximum application rate per year. Do not apply more than 26.8 fl oz of product per acre per year. Do not apply more than 0.268 lb of pydiflumetofen per acre per year. Do not apply more than 0.9 lb of fludioxonil per acre per year. The minimum application interval is 7 days. See label for additions use restrictions. *Efficacy rating is based on laboratory data. **FRAC 7 + 12.**
	thiram (Thiram SC)	2.0 to 2.5 qt	G	24 hr	1 day	Thiram is a broad-spectrum fungicide similar to captan. Do not apply more than 5 applications (12.4 qt product) per year west of the Mississippi River or more than 12 applications per year (29.7 qt product) east of the Mississippi River. See label for active ingredient limits per acre per year and for other restrictions. **FRAC M03.**
	captan (various products and formulations)	*See labels*	G	*See labels*	*See labels*	See product labels for product and/or actitve ingredient season limits. **FRAC M04.**
	*** SEE RESISTANCE MANAGEMENT RECOMMENDATIONS ON PAGES 30 AND 49.***					
	fluopyram + difenoconazole (Luna Flex)	12.0 to 13.6 fl oz	G*	12 hr	0 days	No more than 2 sequential applications or product or of FRAC 7-containing products should be made before alternating with fungicides that have a different mode of action. Do not apply more than 2 applications per year. Do not apply more than 27.2 fl oz of Luna Flex per acre per year. Do not apply more than 0.446 lb of fluopyram per acre per year. Do not apply more than 0.46 lb of difenoconazole per acre per year. *Efficacy rating is based on laboratory data and/or the performance of other similar products. **FRAC 7 + 3.**
	pyrimethanil (Scala SC)	18 fl oz (alone) 9-18 fl oz (tank mix)	G^R	12 hr	1 day	Do not apply more than 54 fl oz of product per acre per crop. See label for additional use restrictions. **FRAC 9.**
	*** SEE RESISTANCE MANAGEMENT RECOMMENDATIONS ON PAGES 30 AND 49.***					

Early Bloom (10%) and into Harvest: Disease Management						
Pest/Problem	**Management Options**	**Amount of Formulation per Acre**	**Effectiveness**	**REI**	**PHI**	**Comments**
Botrytis fruit rot (continued)	**** SEE RESISTANCE MANAGEMENT RECOMMENDATIONS ON PAGES 30 AND 49.****					
	polyoxin D zinc salt (Ph-D) (OSO 5%SC)	 6.2 oz 6.5 to 13 fl oz	G	 4 hr 4 hr	 0 days 0 days	OSO 5%SC is **OMRI-**listed**.** **Ph-D:** Do not apply more than 6 applications of products containing any polyoxin as the active ingredient per season. See label for additional restrictions regarding season limits. **OSO:** Do not apply more than 6 applications at the maximum rate per acre per season. See label for additional restrictions regarding season limits. **FRAC 19.**
Botrytis fruit rot AND anthracnose fruit rot *[Note: Products in this section are labeled for both Botrytis and anthracnose.]*	**** SEE RESISTANCE MANAGEMENT RECOMMENDATIONS ON PAGES 30 AND 49.****					
	pyraclostrobin + boscalid (Pristine)	 18.5 to 23 oz	E^R (anthracnose) G^R (Botrytis)	 12 hr	 0 days	Do not apply more than 115 oz of product per acre per year. Do not apply more than 5 applications at the maximum rate per year. **FRAC 11 + 7.**
	fluopyram + trifloxystrobin (Luna Sensation)	 6 to 7.6 fl oz	E^R	 12 hr	 0 days	Do not apply more than 27.1 fl oz of product per acre per year. Do not apply more than 0.446 lb of fluopyram per acre per year. Do not apply more than 0.6 lb of trifloxystrobin per acre per year. **FRAC 7 + 11.**
	fluxapyroxad + pyraclostrobin (Merivon)	 8 to 11 fl oz	E^R	 12 hr	 0 days	Do not apply more than 3 applications of product per season. Do not apply more than 33 fl oz of product per acre per year. **FRAC 7 + 11.**
	pydiflumetofen + fludioxonil (Miravis Prime)	 11.4 to 13.4 fl oz	E* (Botrytis) G* (anthracnose)	 12 hr	 0 days	Do not make more than 2 consecutive applications of product or of FRAC 7- or FRAC 12-containing products. Do not make more than 2 applications at the maximum application rate per year. Do not apply more than 26.8 fl oz of product per acre per year. Do not apply more than 0.268 lb of pydiflumetofen per acre per year. Do not apply more than 0.9 lb of fludioxonil per acre per year. The minimum application interval is 7 days. See label for additions use restrictions. *Efficacy rating is based on laboratory data and/or the performance of other similar products. **FRAC 7 + 12.**
	**** SEE RESISTANCE MANAGEMENT RECOMMENDATIONS ON PAGES 30 AND 49.****					

Early Bloom (10%) and into Harvest: Disease Management						
Pest/Problem	**Management Options**	**Amount of Formulation per Acre**	**Effectiveness**	**REI**	**PHI**	**Comments**
Botrytis fruit rot AND anthracnose fruit rot *[Note: Products in this section are labeled for both Botrytis and anthracnose.]*	****** SEE RESISTANCE MANAGEMENT RECOMMENDATIONS ON PAGES 30 AND 49.******					
	difenoconazole + cyprodinil (Inspire Super)	16.0 to 20.0 fl oz	VG (Botrytis) G (anthracnose)	12 hr	0 days	No more than 2 sequential applications should be made before alternating with fungicides that have a different mode of action. Do not apply more than 80 fl oz of Inspire Super per acre per year. Do not apply more than 0.46 lb of difenoconazole per acre per year. Do not apply more than 1.3 lb of cyprodinil per acre per year. **FRAC 3 + 9.**
	captan (various products and formulations)	*See labels*	G	*See labels*	*See labels*	For better control and resistance management, use captan plus thiophanate-methyl (see label). See product labels for product and/or actitve ingredient season limits. **FRAC M04.**
	fluopyram + difenoconazole (Luna Flex)	12.0 to 13.6 fl oz	G* (Botrytis F* (anthracnose)	12 hr	0 days	No more than 2 sequential applications or product or of FRAC 7-containing products should be made before alternating with fungicides that have a different mode of action. Do not apply more than 2 applications per year. Do not apply more than 27.2 fl oz of Luna Flex per acre per year. Do not apply more than 0.446 lb of fluopyram per acre per year. Do not apply more than 0.46 lb of difenoconazole per acre per year. *Efficacy rating is based on laboratory data and/or the performance of other similar products. **FRAC 7 + 3.**
	****** SEE RESISTANCE MANAGEMENT RECOMMENDATIONS ON PAGES 30 AND 49.******					
Anthracnose fruit rot	Pristine, Merivon, or Cabrio show the best efficacy against AFR under high anthracnose pressure in research studies and can be used if there is no resistance to FRAC 11 fungicides. Switch 62.5WG also has decent anthracnose control. If weather conditions (warm & wet) favor AFR or you start to approach the upper limit of FRAC 11 fungicides allowed (4 to 5 applications), consider rotating to a tank-mix of captan + Tilt. ****** SEE RESISTANCE MANAGEMENT RECOMMENDATIONS ON PAGES 30 AND 49.******					
	azoxystrobin (Quadris) [*other products available*]	6.0 to 15.5 fl oz *See labels*	E^R (failure found in some fields)	4 hr *See labels*	0 days *See labels*	Do not apply more than 60 fl oz of Quadris per acre per year. Do not apply more than 1.0 lb azoxystrobin per acre per year. See other product labels for product specific limits. In recent research, Quadris and similar products have performed less well than Cabrio/Pristine. **FRAC 11.**
	fluopyram + trifloxystrobin (Luna Sensation)	4.0 to 7.6 fl oz	E^R	12 hr	0 days	Do not apply more than 27.1 fl oz of product per acre per year. Do not apply more than 0.446 lb of fluopyram per acre per year. Do not apply more than 0.6 lb of trifloxystrobin per acre per year. **FRAC 7 + 11.**
	****** SEE RESISTANCE MANAGEMENT RECOMMENDATIONS ON PAGES 30 AND 49.******					

Early Bloom (10%) and into Harvest: Disease Management						
Pest/Problem	**Management Options**	**Amount of Formulation per Acre**	**Effectiveness**	**REI**	**PHI**	**Comments**
Anthracnose fruit rot (continued)	**** SEE RESISTANCE MANAGEMENT RECOMMENDATIONS ON PAGES 30 AND 49.****					
	fluxapyroxad + pyraclostrobin (Merivon)	5.5 to 8 fl oz	E^R	12 hr	0 days	Do not apply more than 3 applications of product per season. Do not apply more than 33 fl oz of product per acre per year. **FRAC 7 + 11.**
	pyraclostrobin + boscalid (Pristine)	18.5 to 23 oz	E^R	12 hr	0 days	Do not apply more than 115 oz of product per acre per year. Do not apply more than 5 applications at the maximum rate per year. **FRAC 11 + 7.**
	pyraclostrobin (Cabrio EG)	12 to 14 oz	E^R	12 hr	0 days	Do not apply more than 70 oz of product per acre per season. Do not apply more than 0.875 lb of pyraclostrobin per acre per season. **FRAC 11.**
	trifloxystrobin (Flint Extra)	2.5 to 3.0 fl oz	E^R	12 hr	0 days	No more than 2 sequential applications should be made before alternating with fungicides that have a different mode of action. Do not apply more than 18 fl oz of product per acre per year. **FRAC 11.**
	**** SEE RESISTANCE MANAGEMENT RECOMMENDATIONS ON PAGES 30 AND 49.****					
	azoxystrobin + difenoconazole (Quadris Top)	12 to 14 fl oz	E^R	12 hr	0 days	Do not apply more than 56 fl oz of product per acre per year. Do not apply more than 0.46 lb of difenoconazole per acre per year. Do not apply more than 1.0 lb of azoxystrobin per acre per year. **FRAC 11 + 3.**
	azoxystrobin + propiconazole (Quilt Xcel)	14 fl oz	E^R	12 hr	0 days	No more than 2 sequential applications should be made before alternating with fungicides that have a different mode of action. Do not apply more than 56 fl oz of product per acre per year. Do not apply more than 0.45 lb of propiconazole per acre per year. Do not apply more than 1.0 lb of azoxystrobin per acre per year. Do not make more than 4 applications of Quilt Xcel per year. **FRAC 11 + 3.**
	difenoconazole + cyprodinil (Inspire Super)	16.0 to 20.0 fl oz	G	12 hr	0 days	No more than 2 sequential applications should be made before alternating with fungicides that have a different mode of action. Do not apply more than 80 fl oz of Inspire Super per acre per year. Do not apply more than 0.46 lb of difenoconazole per acre per year. Do not apply more than 1.3 lb of cyprodinil per acre per year. **FRAC 3 + 9.**
	**** SEE RESISTANCE MANAGEMENT RECOMMENDATIONS ON PAGES 30 AND 49.****					

Early Bloom (10%) and into Harvest: Disease Management						
Pest/Problem	**Management Options**	**Amount of Formulation per Acre**	**Effectiveness**	**REI**	**PHI**	**Comments**
Anthracnose fruit rot (continued)	****** SEE RESISTANCE MANAGEMENT RECOMMENDATIONS ON PAGES 30 AND 49.******					
	captan (various)	*See labels*	G	*See labels*	*See labels*	In plantings known to be infected with the anthracnose crown rot pathogen, consider applying captan plus thiophanate-methyl at 10- to 14-day intervals, for a total of 2 to 3 applications in the fall. See product labels for product and/or actitve ingredient season limits. **FRAC M04.**
	cyprodinil + fludioxonil (Switch 62.5WG)	11 to 14 oz	G	12 hr	0 days	Do not apply more than 56 oz of product per acre per year. Do not apply more than 1.3 lb of cyprodinil or 0.9 lb of fludioxonil per acre per year. **FRAC 9 + 12.**
	pydiflumetofen + fludioxonil (Miravis Prime)	11.4 to 13.4 fl oz	G*	12 hr	0 days	Do not make more than 2 consecutive applications of product or of FRAC 7- or FRAC 12-containing products. Do not make more than 2 applications at the maximum application rate per year. Do not apply more than 26.8 fl oz of product per acre per year. Do not apply more than 0.268 lb of pydiflumetofen or 0.9 lb of fludioxonil per acre per year. The minimum application interval is 7 days. See label for additional use restrictions. *Efficacy rating is based on laboratory data and/or the performance of other similar products. **FRAC 7 + 12.**
	****** SEE RESISTANCE MANAGEMENT RECOMMENDATIONS ON PAGES 30 AND 49.******					
	propiconazole (Tilt) [*other products available*]	4 fl oz *See labels*	F	24 hr *See labels*	0 days *See labels*	No more than 2 sequential applications should be made before alternating with fungicides that have a different mode of action. Do not apply more than 16 fl oz of Tilt per acre per year. Do not apply more than 4 applications of Tilt per year. Do not apply more than 0.45 lb of propiconazole per acre per year. See other product labels for product-specific limits. **FRAC 3.**
	fluopyram + difenoconazole (Luna Flex)	12.0 to 13.6 fl oz	F*	12 hr	0 days	No more than 2 sequential applications or product or of FRAC 7-containing products should be made before alternating with fungicides that have a different mode of action. Do not apply more than 2 applications per year. Do not apply more than 27.2 fl oz of Luna Flex per acre per year. Do not apply more than 0.446 lb of fluopyram or 0.46 lb of difenoconazole per acre per year. *Efficacy rating is based on laboratory data and/or the performance of other similar products. **FRAC 7 + 3.**
	****** SEE RESISTANCE MANAGEMENT RECOMMENDATIONS ON PAGES 30 AND 49.******					

Early Bloom (10%) and into Harvest: Disease Management						
Pest/Problem	**Management Options**	**Amount of Formulation per Acre**	**Effectiveness**	**REI**	**PHI**	**Comments**
Anthracnose crown rot	****** SEE RESISTANCE MANAGEMENT RECOMMENDATIONS ON PAGES 30 AND 49.******					
	difenoconazole + cyprodinil (Inspire Super)	16.0 to 20.0 fl oz	G	12 hr	0 days	No more than 2 sequential applications should be made before alternating with fungicides that have a different mode of action. Do not apply more than 80 fl oz of Inspire Super per acre per year. Do not apply more than 0.46 lb of difenoconazole per acre per year. Do not apply more than 1.3 lb of cyprodinil per acre per year. **FRAC 3 + 9.**
	captan (various products and formulations)	*See labels*	G	*See labels*	*See labels*	In plantings known to be infected with the anthracnose crown rot pathogen, consider applying captan plus thiophanate-methyl at 10- to 14-day intervals, for a total of 2 to 3 applications in the fall. See product labels for product and/or actitve ingredient season limits. **FRAC M04.**
	thiophanate-methyl (Topsin M WSB) [*other products available*]	0.75 to 1 lb *See labels*	G^R	24 hr *See labels*	1 day *See labels*	*For suppression only.* Do not apply more than 4 lb of product per acre per year. Do not apply more than 2.8 lb thiophanate-methyl per acre per year. Do not apply more than 4 applications per year. **FRAC 1.**
	****** SEE RESISTANCE MANAGEMENT RECOMMENDATIONS ON PAGES 30 AND 49.******					
	azoxystrobin + difenoconazole (Quadris Top)	12 to 14 fl oz	G^R	12 hr	0 days	No more than 2 sequential applications should be made before alternating with fungicides that have a different mode of action. Do not apply more than 56 fl oz of product per acre per year. Do not apply more than 0.46 lb of difenoconazole per acre per year. Do not apply more than 1.0 lb of azoxystrobin per acre per year. **FRAC 11 + 3.**
	pydiflumetofen + fludioxonil (Miravis Prime)	11.4 to 13.4 fl oz	G	12 hr	0 days	Do not make more than 2 consecutive applications of product or of FRAC 7- or FRAC 12-containing products. Do not make more than 2 applications at the maximum application rate per year. Do not apply more than 26.8 fl oz of product per acre per year. Do not apply more than 0.268 lb of pydiflumetofen per acre per year. Do not apply more than 0.9 lb of fludioxonil per acre per year. The minimum application interval is 7 days. See label for additional use restrictions. **FRAC 7 + 12.**
	****** SEE RESISTANCE MANAGEMENT RECOMMENDATIONS ON PAGES 30 AND 49.******					
Neopestalotiopsis diseases	See the **Planting and Early Post-planting: Disease Management** recommendations.					

Early Bloom (10%) and into Harvest: Disease Management						
Pest/Problem	**Management Options**	**Amount of Formulation per Acre**	**Effectiveness**	**REI**	**PHI**	**Comments**
Powdery mildew only	See the **Planting and Early Post-planting: Disease Management** recommendations.					
Powdery mildew AND anthracnose fruit rot	****** SEE RESISTANCE MANAGEMENT RECOMMENDATIONS ON PAGES 30 AND 49.******					
	azoxystrobin (Quadris) [*other products available*]	6.0 to 15.5 fl oz *See labels*	E^R	4 hr *See labels*	0 days *See labels*	Do not apply more than 60 fl oz of Quadris per acre per year. Do not apply more than 1.0 lb azoxystrobin per acre per year. See other product labels for product specific limits. **FRAC 11.**
	pyraclostrobin + boscalid (Pristine)	18.5 to 23 oz	E^R	12 hr	0 days	Do not apply more than 115 oz of product per acre per year. Do not apply more than 5 applications at the maximum rate per year. **FRAC 11 + 7.**
	fluopyram + trifloxystrobin (Luna Sensation)	4.0 to 7.6 fl oz	E^R	12 hr	0 days	Do not apply more than 27.1 fl oz of product per acre per year. Do not apply more than 0.446 lb of fluopyram per acre per year. Do not apply more than 0.6 lb of trifloxystrobin per acre per year. **FRAC 7 + 11.**
	pyraclostrobin (Cabrio EG)	12 to 14 oz	E^R	12 hr	0 days	Do not apply more than 70 oz of product per acre per season. Do not apply more than 0.875 lb of pyraclostrobin per acre per season. **FRAC 11.**
	****** SEE RESISTANCE MANAGEMENT RECOMMENDATIONS ON PAGES 30 AND 49.******					
	azoxystrobin + difenoconazole (Quadris Top)	12 to 14 fl oz	E^R	12 hr	0 days	Do not apply more than 56 fl oz of product per acre per year. Do not apply more than 0.46 lb of difenoconazole per acre per year. Do not apply more than 1.0 lb of azoxystrobin per acre per year. **FRAC 11 + 3.**
	azoxystrobin + propiconazole (Quilt Xcel)	14 fl oz	E^R	12 hr	0 days	No more than 2 sequential applications should be made before alternating with fungicides that have a different mode of action. Do not apply more than 56 fl oz of product per acre per year. Do not apply more than 0.45 lb of propiconazole per acre per year. Do not apply more than 1.0 lb of azoxystrobin per acre per year. Do not make more than 4 applications of Quilt Xcel per year. **FRAC 11 + 3.**
	difenoconazole + cyprodinil (Inspire Super)	16.0 to 20.0 fl oz	E (powdery mildew) G (anthracnose)	12 hr	0 days	No more than 2 sequential applications should be made before alternating with fungicides that have a different mode of action. Do not apply more than 80 fl oz of Inspire Super per acre per year. Do not apply more than 0.46 lb of difenoconazole per acre per year. Do not apply more than 1.3 lb of cyprodinil per acre per year. **FRAC 3 + 9.**
	****** SEE RESISTANCE MANAGEMENT RECOMMENDATIONS ON PAGES 30 AND 49.******					

Early Bloom (10%) and into Harvest: Disease Management						
Pest/Problem	**Management Options**	**Amount of Formulation per Acre**	**Effectiveness**	**REI**	**PHI**	**Comments**
Powdery mildew AND anthracnose fruit rot (continued)	****** SEE RESISTANCE MANAGEMENT RECOMMENDATIONS ON PAGES 30 AND 49.******					
	pydiflumetofen + fludioxonil (Miravis Prime)	11.4 to 13.4 fl oz	E* (powdery mildew) G* (anthracnose)	12 hr	0 days	Do not make more than 2 consecutive applications of product or of FRAC 7- or FRAC 12-containing products. Do not make more than 2 applications at the maximum application rate per year. Do not apply more than 26.8 fl oz of product per acre per year. Do not apply more than 0.268 lb of pydiflumetofen per acre per year. Do not apply more than 0.9 lb of fludioxonil per acre per year. The minimum application interval is 7 days. See label for additional use restrictions. *Efficacy rating is based on laboratory data and/or the performance of other similar products. **FRAC 7 + 12.**
	propiconazole (Tilt) [*other products available*]	4 fl oz *See labels*	VG^R (powdery mildew) F (anthracnose)	24 hr *See labels*	0 days *See labels*	No more than 2 sequential applications should be made before alternating with fungicides that have a different mode of action. Not registered for anthracnose crown rot control. Do not apply more than 16 fl oz per acre per year. Do not apply more than 4 applications per year. Do not apply more than 0.45 lb of propiconazole per acre per year. See product labels for product specific limits. **FRAC 3.**
	fluopyram + difenoconazole (Luna Flex)	12.0 to 13.6 fl oz	G* (powdery) F* (anthracnose)	12 hr	0 days	No more than 2 sequential applications or product or of FRAC 7-containing products should be made before alternating with fungicides that have a different mode of action. Do not apply more than 2 applications per year. Do not apply more than 27.2 fl oz of Luna Flex per acre per year. Do not apply more than 0.446 lb of fluopyram per acre per year. Do not apply more than 0.46 lb of difenoconazole per acre per year. *Efficacy rating is based on laboratory data and/or the performance of other similar products. **FRAC 7 + 3.**
	****** SEE RESISTANCE MANAGEMENT RECOMMENDATIONS ON PAGES 30 AND 49.******					
Common leaf spot, leaf scorch, leaf blight (e.g. *Mycosphaerella*, *Phomopsis*, *Gnomonia*)	See **New Leaf Growth to Pre-bloom: Diesease Management** recommendations. Fungicide applications for anthracnose and Botrytis fruit rot are typically sufficient for management of these foliar diseases.					

Harvest: Arthropod Management						
Pest/Problem	**Management Options**	**Amount of Formulation per Acre**	**Effectiveness**	**REI**	**PHI**	**Comments**
Note: Although pyrethroids are labeled for use against many insects, their use often induces spider mite and western flower thrips outbreaks.						
Aphids	See **Pre-bloom to Harvest: Arthropod Management** recommendations.					
Flower thrips	See **Pre-bloom to Harvest: Arthropod Management** recommendations.					
Leaf-rolling and other caterpillars and corn earworm	Leaf-rolling caterpillars are rarely pests in southeastern strawberries and should only be treated if feeding or webbing is on or near fruit. In some location, corn earworm has been observed to cause severe damage.					
	chlorantraniliprole (Coragen eVo)	1.2 to 2.5 fl oz	E	4 hr	1 day	**IRAC 28.**
	spinosad (Entrust 80W) (Entrust SC)	1.25 to 2 oz 4 to 6 fl oz	E	4 hr 4 hr	1 day 1 day	**OMRI**-listed. Rotate to a different class of insect control products after 2 successive applications of spinosad. See product labels for season limits and additional restrictions. **IRAC 5.**
	cyantraniliprole (Exirel)	13.5 to 20.5 fl oz	E	12 hr	1 day	**IRAC 28.**
	cyclaniliprole (Harvanta 50SL)	10.9 to 16.4 fl oz	VG	4 hr	1 day	Use a minimum of 100 to 150 gal of water per acre. Product has a maximum of 3 applications per year. **IRAC 28.**
	methoxyfenozide (Intrepid)	6 to 12 fl oz	VG	4 hr	3 days	**IRAC 18.**
	Bacillus thuringiensis (Bt) (many products)	*See labels*	G	*See labels*	*See labels*	Many Bt formulations are **OMRI**-listed. Bt insecticides have a short residual. Heavy infestations may need repeated applications. Applications are more effective against young larvae. **IRAC 11B.**
Sap beetles	Cultural controls	N/A	Importance: Important	N/A	N/A	Regular, thorough harvest will help minimize sap beetle populations. Sap beetles are attracted to the odor of overripe fruit, so keeping fruit picked clean will reduce problems. Sap beetles can also be attracted away from fields using bucket traps baited with overripe fruit or wheat bread dough. Bait bucket lures and culled strawberries must be **disposed of either off site or buried.** Insecticide treatments should only be used if thorough harvest is not possible (i.e., pick-your-own operations or inclement weather).
	novaluron (Rimon 0.83 EC)	6 to 12 fl oz	E	12 hr	1 day	Allow 7 days between applications. DO NOT apply more than 36 fl oz/acre per season. The use of adjuvants or surfactants is prohibited. **IRAC 15.**
Slugs and snails	See **Pre-bloom to Harvest: Arthropod Management** recommendations.					

Harvest: Arthropod Management						
Pest/Problem	**Management Options**	**Amount of Formulation per Acre**	**Effectiveness**	**REI**	**PHI**	**Comments**
Note: Although pyrethroids are labeled for use against many insects, their use often induces spider mite and western flower thrips outbreaks.						
Tarnished plant bug	Tarnished plant bugs vary in their economic significance throughout the Southeast. Check with local Cooperative Extension personnel to determine if treatment is necessary. If tarnished plant bugs are present, the treatment threshold is generally very low.					
	novaluron (Rimon 0.83 EC)	9 to 12 fl oz	E	12 hr	1 day	Allow 7 days between applications. DO NOT apply more than 36 fl oz/acre per season. The use of adjuvants or surfactants is prohibited. ***Note:*** *Rimon 0.83 EC is not labeled for use against tarnished plant bugs in strawberry. However, the use patterns for labeled pests are consistent with tarnished plant bug control.* **IRAC 15.**
	sulfoxaflor (Transform 50 WG)	1.5 to 2.25 oz	E	24 hr	1 day	DO NOT make applications less than 7 days apart. DO NOT make more than four applications per crop. **IRAC 4C.**
	indoxocarb (Avaunt eVo)	5.0 to 6.0 oz	G	12 hr	1 day	Do not exceed 4 applications per acre per crop. **IRAC 22A.**
	bifenthrin (Brigade eVo)	2.56 to 12.8 oz	G^R	12 hr	0 days	***Restricted use pesticide (RUP).*** The use of broad-spectrum insecticides during bloom will damage honey bee populations. DO NOT apply when bees are foraging. Refer to label. **IRAC 3A.**
	thiamethoxam (Actara 25 WG)	4.0 oz	G	12 hr	3 days	DO NOT exceed a total of 12.0 oz/Acre of Actara or 0.188 lb per acre per growing season. Consider tank-mixing Actara with a pyrethroid for excellent control of plant bugs. **IRAC 4A.**
	fenpropathrin (Danitol 2.4 EC)	10.67 fl oz	G^R	24 hr	2 days	***Restricted use pesticide (RUP).*** DO NOT make more than 2 applications. DO NOT apply when bees are foraging. **IRAC 3A.**
	acetamiprid (Assail 30 SG)	4.0 to 6.9 oz	F	12 hr	1 day	DO NOT make more than 2 applications per calendar year. Consider tank-mixing Assail with a pyrethroid for excellent control of plant bugs. **IRAC 4A.**

Harvest: Arthropod Management						
Pest/Problem	**Management Options**	**Amount of Formulation per Acre**	**Effectiveness**	**REI**	**PHI**	**Comments**
Note: Although pyrethroids are labeled for use against many insects, their use often induces spider mite and western flower thrips outbreaks.						
Spotted-wing drosophila	Spotted-wing drosophila (SWD) larvae have been found in both fall and spring fruiting strawberries in the southeast, but SWD populations are highest during fall. Traps may be useful in determining if SWD treatments are necessary in spring fruiting strawberries. Check with local extension personnel for recommended monitoring methods. Preventative management is strongly recommended in fall fruit strawberries. If SWD is active during strawberry harvest, treat at least weekly and reapply treatments in the event of rain. Pyrethroid insecticides often induce spider mite outbreaks. **Materials effective against SWD are toxic to bees**. Apply SWD treatments in the evening or night when bees are not actively foraging.					
	bifenthrin (Brigade eVo)	2.56 to 12.8 oz	E	12 hr	0 days	***Restricted use pesticide (RUP).*** The use of broad-spectrum insecticides during bloom will damage honey bee populations. DO NOT apply when bees are foraging. Refer to label. **IRAC 3A.**
	spinetoram (Radiant SC)	6 to 10 fl oz	E	4 hr	1 day	**IRAC 5.**
	fenpropathrin (Danitol 2.4 EC)	16 fl oz	VG	24 hr	3 days	***Restricted use pesticide (RUP).*** DO NOT make more than 2 applications. DO NOT apply when bees are foraging. **IRAC 3A.**
	cyantraniliprole (Exirel)	17.5 to 20.5 fl oz	VG	12 h	1 dat	**IRAC 28.**
	malathion (Malathion 57 EC) [*other products available*]	1.5 to 3 pt *See labels*	G	12 hr *See labels*	3 days *See labels*	DO NOT apply when bees are foraging. DO NOT apply more than 3.2 pt in a single application and DO NOT make more than 4 applications per season. The minimum retreatment interval is 7 days. Higher rates may be needed for SWD control. **IRAC 1B.** ***Note:*** *No malathion-containing products currently labeled in strawberries have SWD on the label. However, the use patterns for labeled pests are consistent with SWD control.*
	spinosad (Entrust 80W) (Entrust SC)	1.25 to 2 oz 4 to 6 fl oz	G	4 hr 4 hr	1 day 1 day	**OMRI-**listed. If organic SWD management is needed, be careful not to use Entrust for other pests as there are limited applications per season. Rotate to a different class of insect control products after 2 successive applications of spinosad. See product labels for season limits and additional restrictions. **IRAC 5.**
Twospotted spider mite	Same as **Post-Planting: Arthropod Management** recommendations.					

Harvest: Arthropod Management						
Pest/Problem	**Management Options**	**Amount of Formulation per Acre**	**Effectiveness**	**REI**	**PHI**	**Comments**
Note: Although pyrethroids are labeled for use against many insects, their use often induces spider mite and western flower thrips outbreaks.						
Whiteflies	Whiteflies are rare in open field production, but they can reach damaging densities in high tunnel or greenhouse production. Some materials cannot be used in greenhouses; check labels carefully.					
	imidacloprid (Admire Pro)	1.3 fl oz (foliar)	VG	12 hr	7 days	DO NOT apply when bees are foraging. **IRAC 4A.**
	novaluron (Rimon 0.83 EC)	12 fl oz	VG	12 hr	1 day	Allow 7 days between applications. DO NOT apply more than 36 fl oz/acre per season. The use of adjuvants or surfactants is prohibited. Rimon use is prohibited in greenhouses. ***Note:*** *Rimon 0.83 EC is not labeled for use against whiteflies in strawberry. However, the use patterns for labeled pests are consistent with whitefly control.* **IRAC 15.**
	spiromesifen (Oberon 2 SC)	12 to 16 fl oz	VG	12 hr	3 days	Use only 3 applications per crop. Use in a minimum of 100 gal/acre. Oberon is also an effective miticide. The Oberon label does not prohibit use in greenhouses. **IRAC 23.**
	thiamethoxam (Actara)	3 to 4 oz	G	12 hr	3 days	Do not apply more than 12 oz/acre Actara; allow 10 days between applications. DO NOT apply when bees are foraging; after an Actara application, WAIT FIVE DAYS before placing beehives into treated fields. Actara use is prohibited in greenhouses. **IRAC 4A.**

Effectiveness of Various Chemicals for Strawberry Disease Management[1]

Fungicide[2]		FRAC Group	Relative Efficacy Rating[3] (Very good (VG) and excellent (E) ratings are shaded.)													
			Angular leaf spot	Anthracnose crown rot (*'gloeosporioides'*)	Anthracnose fruit rot (*'acutatum'*)	Botrytis crown rot	Botrytis fruit rot	Common leaf spot	Leaf blight	Leather rot	Mucor fruit rot	Neopestalotiopsis	Phytophthora crown and root rot	Powdery mildew[4]	Red stele root rot	Rhizopus rot
copper[P] (various)		M01	P	NC	NC	NC	NC	P	NC	P	NC	NC	NC	NC	NC	NC
sulfur (various)		M02	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	G	NC	NC
thiram (Thiram SC)		M03	NC	F	F	F	G	F	F	F	F	G	NC	NC	NC	F
captan (various)		M04	NC	G	G	F	G	F	F	F	F	P	NC	NC	NC	F
thiophanate-methyl (Topsin M WSB, others)		1	NC	G[R]	NC	NC[R]	NC[R]	G	G	NC	XX	NC	NC	F[R]	NC	NC
iprodione (Rovral 4F)		2	NC	NC	NC	VG	G[R]	G	NC	NC	XX	NC	NC	NC	NC	NC
DMIs	difenoconazole (Inspire)	3	ND	G	G	ND	ND	ND	ND	ND	ND	F	ND	G	ND	ND
DMIs	flutriafol (Rhyme)	3	ND	ND	ND	ND	ND	ND	ND	ND	ND	F	ND	E[R]	ND	ND
DMIs	mefentriflucon-azole (Cevya)	3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	E[*]	ND	ND
DMIs	myclobutanil (Rally 40WSP)	3	NC	NC	NC	NC	NC	VG	VG	NC	NC	NC	NC	E[R]	NC	NC
DMIs	propiconazole (Tilt, others)	3	NC	F	F	P	P	G	ND	NC	NC	F	NC	VG[R]	NC	NC
DMIs	tetraconazole (Mettle 125ME)	3	ND	ND	ND	ND	ND	ND	ND	ND	ND	NC	ND	E[R]	ND	ND
DMIs	triflumizole (Procure 480SC)	3	NC	NC	NC	ND	ND	ND	ND	NC	NC	NC	NC	E[R]	NC	NC
DMIs	thiophanate-methyl + propiconazole (Protocol)	1 + 3	NC	G[R]	G[R]	G[R]	G[R]	G	G	NC	XX	ND	NC	G[R]	NC	NC
DMIs	difenoconazole + cyprodinil (Inspire Super)	3 + 9	ND	G	G	VG	VG	ND	ND	ND	ND	NC	ND	E	ND	ND
penthiopyrad (Fontelis)		7	NC	F	F	ND	E[R]	NC	NC	NC	NC	ND	NC	G[R]	NC	NC
isofetamid (Kenja 400SC)		7	NC	NC	NC	ND	E[R]	NC	NC	NC	NC	ND	NC	G[R]	NC	NC
fluopyram + difenoconazole (Luna Flex)		7 + 3	NC	F[**]	F[**]	G[**]	G[**]	G[**]	ND	ND	ND	ND	ND	G[**]	ND	ND
fluopyram + pyrimethanil (Luna Tranquility)		7 + 9	NC	NC	NC	ND	E[R]	NC	NC	NC	NC	ND	NC	G[R]	NC	NC
pydiflumetofen + fludioxonil (Miravis Prime)		7 + 12	ND	G[**]	G[**]	VG[**]	E[**]	ND	ND	ND	ND	G[**]	ND	E[**]	ND	ND
pyrimethanil (Scala)		9	NC	NC	NC	ND	G[R]	NC	NC	NC	NC	ND	NC	NC	NC	NC
cyprodinil + fludioxonil (Switch 62.5WG)		9 + 12	ND	G	G	VG	E	F	F	NC	ND	G	NC	ND	NC	ND

[1] These ratings are benchmarks; actual performance will vary. Efficacy ratings do not necessarily indicate a labeled use for every disease.

[2] Fungicides are sorted generally by FRAC group. Fungicides targeting oomycetes are listed together near the end of the table followed by plant activators and biofungicides.

[3] Efficacy Ratings: The efficacy or importance of a management option is indicated by E = excellent, VG = very good, G = good, F = fair, P = poor, NC = no control, and ND = no data. XX indicates that use of this chemical can increase the disease. *Efficacy rating is based on the performance of product in other crops.**Efficacy rating is based on laboratory data and/or the performance of other similar products. [P] Phytotoxicity could occur. [R] Not effective if pathogen is resistant to the fungicide.

[4] Certain fungicides, such as the QoI materials and Protocol, are registered and effective for powdery mildew, but are not recommended when only powdery mildew is present to avoid fungicide resistance selection in the anthracnose and *Botrytis* pathogens.

Effectiveness of Various Chemicals for Strawberry Disease Management (Continued)[1]

Fungicide[2]		FRAC Group	Relative Control Rating[3] (Very good (VG) and excellent (E) ratings are shaded.)													
			Angular leaf spot	Anthracnose crown rot (*'gloeosporioides'*)	Anthracnose fruit rot (*'acutatum'*)	Botrytis crown rot	Botrytis fruit rot	Common leaf spot	Leaf blight	Leather rot	Mucor fruit rot	Neopestalotiopsis	Phytophthora crown and root rot	Powdery mildew[4]	Red stele root rot	Rhizopus rot
Strobilurins (QoIs)	azoxystrobin (Quadris, others)	11	NC	G^R	E^R	ND	F^R	F	NC	VG	NC	NC	NC	E^R	NC	NC
	pyraclostrobin (Cabrio EG)	11	NC	G^R	E^R	ND	F^R	F	NC	VG	NC	ND	NC	E^R	NC	NC
	mandestrobin (Intuity)	11	ND	ND	P	ND	F^R	ND	ND	ND	ND	ND	ND	E^R	ND	ND
	trifloxystrobin (Flint Extra)	11	NC	G^R	E^R	ND	F^R	F	NC	VG	NC	NC	NC	E^R	NC	NC
	azoxystrobin + difenoconazole (Quadris Top)	11 + 3	NC	G^R	E^R	ND	F^R	G	ND	F	NC	NC	NC	E^R	NC	NC
	azoxystrobin + propiconazole (Quilt Xcel)	11 + 3	NC	G^R	E^R	ND	F^R	ND	ND	NC	NC	ND	NC	E^R	NC	NC
	pyraclostrobin + boscalid (Pristine)	11 + 7	NC	G^R	E^R	ND	G^R	VG	VG	NC	ND	ND	NC	E^R	NC	ND
	pyraclostrobin + fluxapyroxad (Merivon)	11 + 7	NC	G^R	E^R	ND	E^R	VG	VG	NC	ND	ND	NC	E^R	NC	ND
	trifloxystrobin + fluopyram (Luna Sensation)	11 + 7	NC	G^R	E^R	ND	E^R	VG	VG	NC	ND	ND	NC	E^R	NC	ND
quinoxyfen (Quintec)		13	NC	NC	NC	NC	NC	NC	NC	NC	NC	ND	NC	E	NC	NC
fenhexamide (Elevate 50 WDG)		17	NC	NC	NC	ND	E^R	NC	NC	NC	NC	ND	NC	NC	NC	NC
polyoxin D (Ph-D; OSO 5%SC)		19	ND	ND	F	ND	G	ND	ND	ND	ND	ND	ND	NC	ND	ND
cyflufenamid (Torino)		U06	NC	NC	NC	NC	NC	NC	NC	NC	NC	ND	NC	VG	NC	NC
flutianil (Gatten)		U13	NC	NC	NC	NC	NC	NC	NC	NC	NC	ND	NC	E	NC	NC
mefenoxam (ReCon Bold SL, Ridomil Gold SL, Thrive 4M, Ultra Flourish)		4	NC	NC	NC	NC	NC	NC	NC	VG^R	NC	NC	VG	NC	VG	NC
metalaxayl (ReCon 4 F)		4	NC	NC	NC	NC	NC	NC	NC	VG^R	NC	NC	VG	NC	VG	NC
oxathiapoprolin + mefenoxam (Orondis Gold)		49 + 4	ND	ND	ND	ND	ND	ND	ND	ND	ND	NC	VG	ND	VG	ND
phosphites (ProPhyt, Phostrol, others)		P07	NC	NC	NC	NC	NC	NC	NC	F	NC	ND	F	NC	F	NC
fosetyl-AL (Aliette WDG, others)		P07	NC	NC	NC	NC	NC	NC	NC	F	NC	ND	F	NC	F	NC
acibenzolar-S-methyl (Actigard 50WG)		P01	P	NC	NC	NC	NC	NC	NC	NC	NC	ND	NC	NC	NC	NC

[1] These ratings are benchmarks; actual performance will vary. Efficacy ratings do not necessarily indicate a labeled use for every disease.

[2] Fungicides are sorted generally by FRAC group. Fungicides targeting oomycetes are listed together near the end of the table followed by plant activators and biofungicides.

[3] Efficacy Ratings: The efficacy or importance of a management option is indicated by E = excellent, VG = very good, G = good, F = fair, P = poor, NC = no control, and ND = no data. XX indicates that use of this chemical can increase the disease. [P] Phytotoxicity could occur. [R] Not effective if pathogen is resistant to the fungicide.

[4] Certain fungicides, such as the QoI materials and Protocol, are registered and effective for powdery mildew, but are not recommended when only powdery mildew is present to avoid fungicide resistance selection in the anthracnose and *Botrytis* pathogens.

Effectiveness of Various Chemicals for Strawberry Arthopod Management[1]															
		Relative Control Rating[3] (Very good (VG) and excellent (E) ratings are shaded.)													
Insecticide/Mollusicides[2]	**IRAC Group**	**Imported fire ants**	**Aphids**	**Crickets**	**Cutworms**	**Cyclamen mites**	**Flower thrips**	**Leaf-rolling caterpillars**	**Sap beetles**	**Slugs and snails**	**Spotted-wing drosophila**	**Strawberry clippers**	**Tarnished plant bugs**	**Twospotted spider mites**	**Whiteflies**
carbaryl (Sevin 4F, Sevin XLR)	1A	ND	ND	G	G	ND	ND	ND	ND	F	ND	G	VG	ND	ND
malathion (various)	1B	ND	F	F	G	ND	ND	ND	F	ND	VG	ND	F	ND	ND
bifenthrin (Brigade eVo)	3A	ND	F	ND	G	ND	VG	G	ND	ND	VG	VG	G	ND	ND
fenpropathrin (Danitol 2.4 EC)	3A	ND	ND	ND	ND	ND	ND	ND	ND	ND	VG	VG	G	ND	ND
acetamiprid (Assail 30SG)	4A	ND	VG	ND	G	ND	G	G	G	ND	ND	G	F	ND	F
imidacloprid (Admire Pro)	4A	ND	VG	ND	ND	ND	F	ND	ND	ND	ND	ND	F	ND	VG
thiamethoxam (Platinum, Actara)	4A	ND	G	ND	ND	ND	ND	ND	ND	ND	ND	ND	G	ND	G
sulfoxaflor (Transform)	4C	ND	E	ND	ND	ND	ND	ND	ND	ND	ND	ND	E	ND	G
flupyradifurone (Sivanto 200 SL)	4D	ND	VG	ND	ND	ND	F	ND	ND	ND	ND	ND	ND	ND	ND
spinetoram (Radiant SC)	5	ND	ND	ND	VG	ND	G	E	ND	ND	E	ND	ND	ND	ND
spinosad (Entrust 80W, Entrust SC)	5	ND	ND	ND	VG	ND	G	VG	ND	ND	G	ND	ND	ND	ND
abamectin (Agri-Mek SC)	6	ND	ND	ND	ND	VG	ND	ND	ND	ND	ND	ND	ND	VG	ND
methoprene (Extinguish Professional Fire Ant Bait 0.5% B)	7A	VG	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
pyriproxyfen (Esteem Ant Bait 0.5% B)	7C	VG	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
hexythiazox (Savey 50 DF)	10A	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	G	ND
etoxazole (Zeal)	10B	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	VG	ND
Bacillus thuringiensis (various)	11B2	ND	ND	ND	G	ND	ND	G	ND	ND	ND	ND	ND	ND	ND
funbutatin-oxide (Vendex 50WP)	12B	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	P	ND
novaluron (Rimon 0.83 EC)	15	ND	ND	ND	F	ND	G	F	E	ND	ND	ND	E	ND	VG
methoxyfenozide (Intrepid)	18	ND	ND	ND	VG	ND	ND	VG	ND	ND	ND	ND	ND	ND	ND
acequinocyl (Kanemite 15 SC)	20B	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	E	ND
bifenazate (Acramite 50WP, Vigilant 4SC)	20D	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	E	ND
fenazaquin (Magister)	21A	ND	ND	ND	ND	VG	ND	ND	ND	ND	ND	ND	ND	VG	ND
fenpyroximate (Portal)	21A	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	VG	ND

[1] These ratings are benchmarks; actual performance will vary. Efficacy ratings do not necessarily indicate a labeled use for every insect.
[2] Insecticides are sorted in alphabetical order by the active ingredient.
[3] Efficacy Ratings: The efficacy or importance of a management option is indicated by E = excellent, VG = very good, G = good, F = fair, P = poor, NC = no control, and ND = no data.

Effectiveness of Various Chemicals for Strawberry Arthopod Management[1]															
		Relative Control Rating[3] (Very good (VG) and excellent (E) ratings are shaded.)													
Insecticide/Mollusicides[2]	**IRAC Group**	**Imported fire ants**	**Aphids**	**Crickets**	**Cutworms**	**Cyclamen mites**	**Flower thrips**	**Leaf-rolling caterpillars**	**Sap beetles**	**Slugs and snails**	**Spotted-wing drosophila**	**Strawberry clippers**	**Tarnished plant bugs**	**Twospotted spider mites**	**Whiteflies**
indoxacarb (Avaunt eVo)	22A	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	G	ND	ND
spiromesifen (Oberon 2SC)	23	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	E	E
cyflumetofen (Nealta)	25	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	E	ND
chlorantraniliprole (Coragen eVo)	28	ND	ND	ND	E	ND	ND	E	ND	ND	ND	ND	ND	ND	ND
cyantraniliprole (Exirel)	28	ND	G	ND	ND	ND	VG	E	ND	ND	VG	ND	ND	ND	VG
cyclaniliprole (Harvanta 50SL)	28	ND	F	ND	ND	ND	G	E	ND	ND	ND	ND	ND	ND	F
horticultural oil (various)	UNE	ND	F	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	G	ND
rosemary & peppermint oils (various)	UNE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	F	ND
insecticidal soap (M-Pede)	--	ND	F	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	F	ND
iron phosphate (Sluggo Snail and Slug Bait)	--	ND	ND	ND	ND	ND	ND	ND	ND	G	ND	ND	ND	ND	ND
metaldehyde (Deadline Bullets and MPs)	--	ND	ND	ND	ND	ND	ND	ND	ND	G	ND	ND	ND	ND	ND
predatory mites (various)	--	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	VG	ND
sucrose octanoate (SucraShield)	--	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	F	ND

[1] These ratings are benchmarks; actual performance will vary. Efficacy ratings do not necessarily indicate a labeled use for every insect.
[2] Insecticides are sorted in alphabetical order by the active ingredient.
[3] Efficacy Ratings: The efficacy or importance of a management option is indicated by E = excellent, VG = very good, G = good, F = fair, P = poor, NC = no control, and ND = no data.

Plasticulture Weed Control

Note: Dormant applications do not mean winter. It means matted row only. Plasticulture strawberries do not go dormant.

Plasticulture Weed Control: Preplant					
Weed	**Management Options**	**Amount of Formulation per Acre**	**Crop Age Restrictions**	**REI**	**Comments**
Yellow and purple nutsedge: Nutsedge species are very difficult to control in strawberry grown on plastic mulch. They are able to penetrate plastic mulch soon after laying mulch and throughout the growing season. Eptam (EPTC) will provide good control of yellow nutsedge when applied at least 45 days before transplanting strawberry. The best control strategy is to use Spartan (a.i. sulfentrazone), which provides excellent control of yellow nutsedge and reduces tuber viability. There are no POST herbicides registered in strawberry that will control emerged yellow nutsedge. Refer to the product label for specific use information and contact your local county Extension agent if you have questions. Electronic product and supplemental labels are available in various online pesticide label databases and can be used to obtain more information before choosing a herbicide. These databases also often provide information regarding state registrations. See the General Pesticide Information section for a list of online databases.					
Annual grasses, broadleaf weeds, and yellow and purple nutsedge	Fumigation (See table on page 29.)	See labels	See labels	See labels	Annual grass and broadleaf weeds.
Yellow and purple nutsedge, annual broadleaf weeds, and annual grasses	EPTC (Eptam 7E)	3.5 to 7 pt	Apply to soil surface at least 45 days before planting. **Note: Eptam can only be applied in the fallow period; see label for application instructions and restrictions.**	12 hr	For best control of nutsedge, soil must have enough moisture for tuber sprouting. Allow 10 to 14 days for nutsedge tuber sprouting to occur, and then lightly till to destroy shoots and dry the soil surface. Apply and incorporate Eptam 7E to prevent volatilization; immediately incorporate into soil to a depth of approximately 2 to 4 inches. If possible, use a leveling device behind the incorporating equipment to leave soil surface as smooth as possible. Field traffic, excessive rainfall or irrigation, and other soil disturbances will reduce the level of nutsedge suppression. To avoid injury to following crops, irrigating at least 30 days prior to planting is recommended. **MOA 8.**
Annual broadleaf weeds, including Carolina geranium and cutleaf evening primrose	oxyfluorfen (Goal 2 XL)	up to 2 pt	Apply to soil surface of pre-formed beds at least 30 days before transplanting.	24 hr	Plastic mulch should be applied soon after Goal application. Best results occur when plastic is applied immediately after herbicide application. Incorporation is not necessary, but it may result in less crop injury. Soil disturbance after application will reduce weed control. **MOA 14.**

Plasticulture Weed Control: Preplant					
Weed	**Management Options**	**Amount of Formulation per Acre**	**Crop Age Restrictions**	**REI**	**Comments**
Annual broadleaf weeds	acifluorfen (Ultra Blazer 2 L)	0.5 to 1.5 pt	Apply banded application to row prior to laying plastic mulch and after final land preparation, and prior to transplanting.	48 hr	**Crop row.** Make one banded application before laying plastic mulch and after final land preparation, and prior to transplanting the crop. For best results, avoid soil disturbance during laying of plastic and planting of crop. **MOA 14.**
Annual broadleaf weeds including cutleaf evening primrose, henbit, chickweed, horseweed, pigweed species, wild radish and suppression of some annual grasses	flumioxazin (Chateau SW 51 WDG)	3 oz	Apply to soil surface of pre-formed beds at least 30 days before transplanting.	12 hr	**Crop row.** Apply a minimum of 30 days prior to transplanting and prior to plastic mulch being laid. **MOA 14.**
Broadleaf weeds including common chickweed, redroot and smooth pigweed, common lambsquarters and some annual grasses	napropamide (Devrinol and Devrinol 2-XT 2 EC) (Devrinol and Devrinol DF-XT 50 DF)	8 qt 8 lb	Apply to soil surface of pre-formed beds before laying plastic mulch.	24 hr	Devrinol applied to the bed before laying the plastic has potential to injure strawberry plants. For plant bed preplant treatment, incorporate to weed-free soil before laying plastic mulch. Soil should be well worked yet moist enough to permit a thorough incorporation to a depth of 2 inches. Incorporate within 24 to 72 hr (depending on formulation) of application before laying plastic mulch. If weed pressure is from small-seeded annuals, apply Devrinol to the surface of the bed immediately before laying the plastic mulch. If soil is dry, water or sprinkler irrigate with sufficient water to wet to a depth of 2 to 4 inches before laying the plastic mulch. Apply the plastic mulch over the treated soil within 24 to 72 hr. **MOA 15.**
Yellow nutsedge, purple nutsedge, corn spurry, yellow woodsorrel, henbit, chickweed, suppression of curly dock	sulfentrazone (Spartan 4F)	4 to 8 oz (see label for soil restrictions)	Apply to soil surface of pre-formed beds.	12 hr	Rate is soil-type dependent. Use lower rate for coarse soils. Apply prior to planting and before weeds have emerged. Please refer to label for soil type restrictions. **Spartan has a 24C label in some states. MOA 14.**

Plasticulture Weed Control: Postemergence					
Weed	**Management Options**	**Amount of Formulation per Acre**	**Crop Age Restrictions**	**REI**	**Comments**
Broadleaf weeds including ragweed, clover, vetch, curly dock, dandelion, sowthistle, thistle, red sorrel, and nightshade	clopyralid (Stinger 3 EC)	**Crop row:** 0.33 to 0.5 pt **Row middle:** 0.33 to 0.67 pt	Apply after strawberry plants are established and at least 30 days before harvest.	12 hr	DO NOT apply within 30 days of harvest. DO NOT use a surfactant or apply in combination with other pesticides or crop injury may occur. DO NOT apply as a broadcast application. DO NOT compost treated vegetation if compost will be used on sensitive plants. **Stinger has a 24C label in some states. MOA 4.**
Annual and perennial grasses	clethodim (Arrow, Clethodim, Intensity, Select 2EC) (Intensity One, Select Max 1EC)	6 to 8 oz 9 to 16 oz	Newly planted or established plantings	12 hr	Use high rate and sequential applications for perennial grasses (bermudagrass or johnsongrass). The addition of a nonionic surfactant at 0.25 % v/v (1 qt per 100 gal of spray solution) or crop oil concentrate at 1% v/v (1 gal per 100 gal of spray solution) is required for optimum results. Do not apply within 4 days of harvest. With Select Max, add 0.25% nonionic surfactant (1 qt per 100-gallon spray mix). **MOA 1.**
Annual and perennial grasses	sethoxydim (Poast 1.5 EC)	1 to 1.5 pt	Newly planted and established plantings	12 hr	Sequential applications will be necessary for perennial grass control. The addition of a nonionic surfactant (1 qt per 100 gal of water) or crop oil concentrate (1 gal per 100 gal of water) is necessary for optimum results. Do not apply within 7 days of harvest. Total use cannot exceed 2.5 pt per acre per year. **MOA 1.**

Plasticulture Weed Control: Row Middles					
Weed	**Management Options**	**Amount of Formulation per Acre**	**Crop Age Restrictions**	**REI**	**Comments**
Small seeded annual broadleaf weeds including common chickweed, redroot and smooth pigweed, common lambsquarters and some annual grasses	napropamide (Devrinol DF-XT 50 DF, Devrinol 50 DF) (Devrinol 2-XT 2 EC)	8 lb 8 qt	Do not apply post-transplant if new foliage is exposed to spray.	24 hr	Apply as a banded preemergence treatment to the middles between plastic before weed emergence. Tank mixture with paraquat will provide preemergence and postemergence weed control. Rainfall or irrigation within 24 hr after Devrinol application is needed for optimum control. Effective on volunteer small grains (wheat, etc.) if applied before emergence. Do not apply after bloom. **MOA 15.**
Annual grasses and small seeded broadleaf weeds	pendimethalin (Prowl H_2O 3.8 EC)	1.5 pt	Do not apply post-transplant if new foliage is exposed to spray.	24 hr	Avoid contact with strawberry plant. See label for more information. PHI = 35 days. **MOA 3.**
Annual broadleaf weeds	acifluorfen (Ultra Blazer 2 L)	0.5 to 1.5 pt	Apply with a shielded sprayer to middles between plastic.	48 hr	DO NOT ALLOW ULTRA BLAZER TO CONTACT STRAWBERRY PLANTS. Apply as a direct-shielded application. **MOA 14.**
Annual broadleaf weeds including cutleaf evening primrose, henbit, chickweed, horseweed, pigweed species, wild radish and suppression of some annual grasses	flumioxazin (Chateau SW 51 WDG)	3 oz	Apply with a hooded or shielded sprayer to middles between plastic.	12 hr	Apply for preemergence weed control in the middles. DO NOT APPLY AFTER FRUIT SET. Do not allow spray solution to come in contact with fruit or foliage. Spotting may occur. May kill or injure ryegrass in middles. **MOA 14.**
Nonselective weed control	glyphosate (various formulations)	See labels	Apply with hooded sprayer or wiper applicator.	4 hr	To prevent SEVERE crop injury, use application equipment and technique that will prevent contact with any portion of the crop or plastic. Do not apply within 14 days of harvest. **MOA 9.**
	paraquat (Parazone 3 SL) (Gramoxone SL 2L)	1.3 pt 2 pt	Apply with hooded sprayer or shields to protect crop.	12 hr	Contact kill of all green foliage. Do not allow drift or spray solution to contact crop or severe injury or crop death will occur. The addition of a nonionic surfactant at 0.25 % v/v (1 pt per 50 gal of spay solution) is required for optimum results. Apply in a minimum spray volume of 20 gal per acre. Do not make more than 3 applications per year. **MOA 22.**
	pelargonic acid (Scythe 4 EC)	3 to 10% v/v	Apply with hooded or shielded sprayer for weed control in row middles.	12 hr	Product is a nonselective, contact herbicide with foliar activity. May be tank mixed with soil residual herbicides for extended weed control. Avoid contact with strawberry plant or severe injury will occur. **MOA 27.**

Plasticulture Weed Control: Row Middles					
Weed	**Management Options**	**Amount of Formulation per Acre**	**Crop Age Restrictions**	**REI**	**Comments**
Annual broadleaf weeds. Most effective on weeds less than 4 in. tall or rosettes less than 3 in. in diameter	carfentrazone (Aim 2 EC, Aim 1.9 EW)	up to 2 oz	Apply with hooded sprayer to middles between plastic.	12 hr	Apply post-directed using hooded sprayer for control of emerged weeds in row middles. If crop is contacted, burning of contacted area will occur. Most effective on weeds less than 4 inches tall or rosettes less than 3 inches across. Use a crop oil concentrate at up to 1 gal per 100-gallon solution or a nonionic surfactant at 2 pt per 100 gal of spray solution. Coverage is essential for good weed control. Does not control grass weeds. **MOA 14.**

Matted Row Weed Control

Matted Row Weed Control: Preplant					
Weed	**Management Options**	**Amount of Formulation per Acre**	**Crop Age Restrictions**	**REI**	**Comments**
Annual grasses, broadleaf weeds, and yellow and purple nutsedge	Fumigation (See table.)	See labels	See labels	See labels	See labels for rates, plant-back intervals, and personal protective equipment requirements.

Matted Row Weed Control: Preemergence					
Weed	**Management Options**	**Amount of Formulation per Acre**	**Crop Age Restrictions**	**REI**	**Comments**
Annual grasses and small-seeded broadleaf weeds	napropamide (Devrinol, Devrinol 2-XT 2 EC) (Devrinol, Devrinol DF-XT 50 DF)	8 qt 8 lb	Established strawberries	12 hr	Apply any time prior to weed emergence except for the interval between bloom and harvest. Rainfall or irrigation within 24 hr is needed for optimum weed control. See XT labels for information regarding delay in irrigation event. **MOA 15.**
Annual broadleaf weeds and grasses including chickweed, henbit, annual pepperweed, Shepherd's purse	terbacil (Sinbar 80 WDG)	See label	Newly planted and established plantings	12 hr	See label for soil type and organic matter content restrictions. For winter weed control, apply 2 to 6 oz per acre in late summer or early fall. If strawberry plants are not dormant, the application must be followed immediately by 0.5 to 1 inches of overhead irrigation or rainfall. For extended control through harvest the following year, apply 2 to 4 oz per acre prior to mulching in late fall. In established plantings, apply 4 to 8 oz post-harvest renovation before new growth begins in mid-summer. For extended weed control through harvest the following year, apply 4 to 8 oz per acre prior to mulching in late fall. Do not apply within 110 days of harvest. See label for more information. **MOA 5.**
Annual broadleaf weeds including yellow rocket, shepherd's purse, Virginia pepperweed, common chickweed, common groundsel	acifluorfen (Ultra Blazer 2L)	0.5 to 1.5 pt	Apply after the last harvest or following bed renovation or when plants are dormant.	48 hr	Two applications can be made. Do not apply the last application within 120 days of strawberry harvest. **MOA 14.**

Matted Row Weed Control: Preemergence					
Weed	**Management Options**	**Amount of Formulation per Acre**	**Crop Age Restrictions**	**REI**	**Comments**
Annual broadleaf weeds	flumioxazin (Chateau SW 51 WDG)	3 oz	Apply with hooded or shielded sprayer to row middles.	12 hr	DO NOT spray over top of strawberries. Apply prior to weed emergence. Crop spotting may occur if spray contacts the crop. DO NOT apply after fruit set. **MOA 14.**
Yellow nutsedge, purple nutsedge, corn spurry, yellow woodsorrel, henbit, chickweed and other broadleaf weeds	sulfentrazone (Spartan 4F)	4 to 8 oz (see label for soil restrictions)	Preplant	12 hr	See label for soil type and organic matter content restrictions. Do not apply after the crop has been transplanted or serious injury may occur. **Spartan 4F has a 24C label in some states. MOA 14.**

Matted Row Weed Control: Postemergence					
Weed	**Management Options**	**Amount of Formulation per Acre**	**Crop Age Restrictions**	**REI**	**Comments**
Broadleaf weeds including ragweed, clover, vetch, dock, cocklebur, dandelion, red sorrel, sowthistle, thistle, and nightshade	clopyralid (Stinger 3 EC)	0.33 to 0.67 pt	Newly planted and established plantings	12 hr	Apply in the spring before harvest or post-harvest. Do not apply within 30 days of harvest. Do not use a surfactant or apply in combination with other pesticides. **Stinger has a 24C label in some states. MOA 4.**
Broadleaf weeds	2, 4-D amine (Embed Extra 3.8 L)	2 to 3 pt	Established plantings	48 hr	Apply to well-established strawberries after harvest and before runners form or when crop is dormant. Not more than two treatments per year. Do not apply during bud, flower, or fruit stage. Timing is very critical to avoid damage. Do not apply unless possible injury to the crop is acceptable. **MOA 4.**
Annual broadleaf weeds	pelargonic acid (Scythe 4 EC)	3 to 10% v/v	Apply as a directed or shielded spray.	12 hr	Product is nonselective, contact herbicide with foliar activity. May be tank mixed with soil residual herbicides for extended weed control. Avoid contact with strawberry plant or severe injury will occur. **MOA 27.**

Matted Row Weed Control: Postemergence					
Weed	**Management Options**	**Amount of Formulation per Acre**	**Crop Age Restrictions**	**REI**	**Comments**
Contact kill of all green foliage	paraquat (Parazone 3 SL) (Gramoxone SL 2L)	1.3 pt 2 pt	Apply with hooded sprayer or shields to protect crop.	12 hr	Contact kill of all green foliage. Do not allow drift or spray solution to contact crop or severe injury or crop death will occur. The addition of a non-ionic surfactant at 0.25 % v/v (1 pt/50 gal. of spay solution) is required for optimum results. Apply in a minimum spray volume of 20 gal. per acre. Do not make more than 3 applications per year. **MOA 22.**
Annual and perennial grasses	clethodim (Select, Clethodim, Arrow, Intensity 2 EC) (Select Max, Intensity One 1 EC)	6 to 8 oz 9 to 16 oz	Newly planted or established plantings	12 hr	Use high rate, and sequential applications are for perennial grasses (bermudagrass or johnsongrass). The addition of a non-ionic surfactant at 0.25 % v/v (1 qt/100 gal. of spray solution) or crop oil concentrate at 1% v/v (1 gal per 100 gal. of spray solution) is required for optimum results. Do not apply within 4 days of harvest. With Select Max, add 0.25% non-ionic surfactant, 1 qt per 100 gal spray mix. **MOA 1.**
	fluazifop (Fusilade DX)	12 to 24 oz	Newly planted (non-bearing only)	12 hr	Sequential applications will be necessary for perennial grass control. The addition of a non-ionic surfactant (1 qt/100 gal of water) or crop oil concentrate (1 gal/100 gal of water) is necessary for optimum control. **MOA 1.**
	sethoxydim (Poast 1.5 EC)	1 to 1.5 pt	Newly planted and established plantings	12 hr	Sequential applications will be necessary for perennial grass control. The addition of a non-ionic surfactant (1 qt/100 gal of water) or crop oil concentrate (1 gal/100 gal. of water) is necessary for optimum results. Do not apply within 7 days of harvest. Total use cannot exceed 2.5 pt/acre. **MOA 1.**

Wildlife Damage Prevention

Efforts to control birds and other wildlife that damage fruit crops should be focused on the perimeter of the planting first, especially on the side(s) facing favorable wildlife habitat. This is where the first damage will be observed and, in some cases, it may be sufficient to head off the problem. However, don't discontinue monitoring for wildlife damage throughout the planting. Bird damage can come from any direction; terrestrial wildlife are most likely to use surrounding cover and approach the planting from one side.

Birds

Crop losses to birds appear to be increasing in small fruit crops. Not only do birds consume fruit, but the damage they cause can result in increased problems with fruit rots and other pests such as bees and yellow jackets. Several different types of birds can cause problems. Robins, starlings and mockingbirds are among the more common ones, but orioles, cedar waxwings and finches may also feed on small fruit crops. Wild turkeys are also a problem; often feeding from below and getting under protective netting.

Feeding pressure will be heavier in fields that are close to roosting or nesting sites such as woodlands, hedgerows, grassy fields, power lines and individual trees. Birds may feed, fly to these resting sites, and then return to the crop later in the day. While birds can and do fly fairly long distances (up to 1 mile or more) to feed, the further they have to fly, the more apt they are to not find the fruit crop or to be distracted by another food source. The presence of a pond, creek or other water source nearby is another factor that may lead to increased feeding pressure. Typically, bird damage tends to be more severe in the earlier parts of the growing season, and damage lessens as the season progresses.

There are several control techniques which may be of value in decreasing losses to birds. They include visual, auditory and chemical repellents and exclusion (netting). For any method to be successful, it must be instituted before birds establish a feeding pattern, which generally means that they should be in place and operating at the time that color change occurs in the fruit. With the exception of exclusion, no one method should be relied on for control. Exclusion can easily fail if not installed correctly or installed at the wrong time.

Almost all birds are state and federally protected and lethal control methods are not generally available to growers. Non-lethal methods such as exclusion (netting) are often sufficient when properly installed. Visual deterrents are usually ineffective as birds quickly learn to ignore these stimuli. Auditory distress calls and chemical repellents can be more effective. Chemical repellents can impart an off flavor to the fruit crop.

Auditory repellents

Auditory scare devices such as propane cannons, noise makers or distress calls may offer temporary relief for some types of birds. Regardless of which one or ones is/are used, the following points should be considered to attain the best results:

- Assess the potential for objections to the noise from your neighbors.
- Start before birds establish a feeding pattern.
- Operate control devices beginning shortly before sunrise and continuing until just after sunset, as early and late in the day may be the most intense feeding times.
- Vary the frequency, the direction and the timing in which auditory devices are operated. Propane cannons should not be fired at intervals closer than 3 minutes.
- Consider using more than one type of auditory device and possibly combine them with visual repellents.
- If using distress calls, it is essential to identify the type(s) of birds you want to discourage and get distress calls specific to them.

Birds (Continued)

Auditory repellents (Continued)

- Reinforce the sense of danger by shooting, if allowed. Shooting is generally NOT allowed for game birds, like turkey, or migratory songbirds. State and Federal permits would be required. Financial and legal penalties can be severe for violations. Federal law is a "strict liability" law; the act of shooting/killing alone is sufficienct to trigger penalties, and there is no need to prove intent.

Visual repellents

Visual repellents include such things as scare eyes suspended above the crop, mylar tape on the canopy of the crop, aluminum pie pans, plastic owls and plastic snakes. These range from ineffective (plastic effigies) to moderately effective for a short period of time. Birds will get used to them quickly if they are not moved around or if another type of repellent is not used along with it. Yellow scare eyes suspended above the crop and allowed to move freely have been reported to have some impact on blackbirds, however, robins do not seem to be affected. Geese have been observed feeding directly under several scare eyes. Kites or silhouettes of hawks – attached to a short string and poles around the crop may have limited efficacy. The silhouette should "fly" easily in natural breeze or wind so that the movement stresses and disturbs the feeding birds. The inflatable man (aka. Tall man, sky man, air dancer, Tall Boy) has also been reported to work. The erratic, sudden movements make it harder for birds to get used to. To further increase the effectiveness, sound could be added.

Chemical repellents

Methyl anthranilate (MA) is registered as a bird repellent. While it is sometimes advertised as a taste repellent, this is not exactly correct. When sprayed on a crop, it causes an unpleasant sensation in the bird's mouth. Methyl anthranilate is a naturally occurring material used in the food service industry. Early reports have been inconsistent in regard to its effectiveness. It has also been reported to impart an undesirable foxy flavor to certain grape varieties. Methyl anthranilate has a short residual, so frequent reapplication will be necessary to achieve lasting results. Results may vary depending on the type of birds. Combining with another type of deterrent may result in greater effect than when used alone. As with other types of deterrents, applications need to start before birds establish feeding patterns.

Exclusion

Exclusion (netting) is the only consistently effective method of reducing bird damage. Netting is more expensive than other types of deterrents and can require fair amounts of labor, so it may not be an economically viable alternative in all situations. Nets are either laid on the canopy of the crop or, preferably, suspended from a framework over the crop. The fruiting area of the plant needs to be completely protected. Birds will enter the canopy of the plant from below the net if it is open under the plant. If used with care, nets can be maintained for use over several years. For crops requiring multiple harvests such as blueberry, suspending the netting over the crop and around the sides of the field will allow easier access to the crop. If nets are placed directly on the crop canopy, birds can perch on it and feed on berries below them. For smaller operations (and non-commercial operations), inexpensive frames can easily be created with PVC pipes to form a structure that would then support bird-deterrent netting. Such netting can be easily erected and removed prior to and after fruiting, respectively.

Lasers

Lasers are receiving much more attention as a tool for preventing bird damage in some crops. Although little scientifically sound research has been done looking at the use of lasers, this is increasing. Testimonials touting the effectiveness of lasers abound. While their cost may seem hig, lasers might be less expensive to install and operate (with perhaps better results) than most other types of bird control.

Birds (Continued)

Lasers (Continued)

A green laser beam works better than a red one as birds can see it throughout the day. Birds perceive the laser beam as a physical object, triggering a flight response as it moves toward them. Depending on topography, one automated llaser system may cover several acres. Like all other methods of bird control, lasers work best when they are started before birds establish a feeding program in the crop. They should be operated beginning an hour before sunrise, and run continuously until an hour following sunset, as early and late in the day are the most intense feeding times for birds. The pattern and frequency of beam discharge should be changed frequently to avoid habituation. Using other control techniques in combination with lasers will offer expanded bird damage control. The effectiveness of lasers will vary depending on the bird species and the terrain of the area to be protected.

The misuse of laser devices poses a serious threat to aviation safety. Be sure to check regulations governing their use in your area prior to purchasing and using lasers for crop protection.

Lasers should be turned off when workers are present in the field being protected.

Wild turkeys are becoming more of a problem in many areas of the country. While there is no doubt that they do consume some fruit, research has shown that turkeys are often after insects instead of fruit. They do not appear to like loud and/or distressing sounds. While netting will work, turkeys can tear holes in it for access to the fruit. Turkeys may be eating fruit but are most likely consuming the insects attracted to ripening fruit. Timely harvest can help minimize turkey damage but unharvested, over ripe may remain on the ground and further serve to attract insects.

Deer

Deer can damage small fruit plantings by foraging on succulent new growth during the growing season or by eating fruit. In fall, bucks can damage plants by rubbing their antlers on stems and stalks. This is more of a problem in tree fruits than small fruits. Deer can also puncture plastic mulch and possibly the irrigation tape underneath, resulting in loss of weed control and irrigation capability. Deer numbers are increasing or already very high in some areas and incidents of deer damaging crops are also increasing. Deer populations are increasing across most of their range. Hunting on neighboring properties can reduce local damage but neighboring hunting clubs may be actively working to increase deer populations. Hunters should be encouraged to harvest does as opposed to bucks to have much of an impact on deer populations. Most state wildlife departments provide out-of-hunting-season deer depredation permits for producers with a documented deer damage problem. Producers should contact their state wildlife agency for information on depredation permits.

Locating the planting away from favorable habitat for deer will help to lessen losses. However, this is not generally possible; deer travel 1 to 1.5 miles and it is highly unlikely that anyone can locate plantings sufficiently far from suitable habitat. Several management options do exist. Determining which one or ones to use depends on the deer population, availability of other food sources, location of favorable habitat, the duration for which protection is needed, and the value of the crop to be protected.

Repellents

Both taste and smell repellents are available for use. Smell repellents include commercially available products or materials such as tankage, blood, putrified egg solids, and certain soaps. While these products may be effective in the short term, repellents will not provide long-term control and will not provide control when populations are high or alternate food sources are scarce. Repellents, such as biosolids (for example, Milorganite® and chicken litter), are also effective. All repellents are biodegradable and need to be applied regularly and after rain or overhead irrigation.

Deer (Continued)

Repellents (Continued)
Some repellents are not labeled for use on products intended for human consumption (for example, repellents with rotten or "putrified" egg as the active ingredient). Please read product labels carefully and use products as instructed. Lethal control is generally necessary to reduce deer populations to tolerable densities before repellents can have an effect. Overabundant deer herds are unlikely to respond to repellents. Consult your state wildlife resource department for lethal control options such as hunting and crop depredation permits. State wildlife agencies can issue additional doe permits in many situations.

Exclusion
Exclusion (fencing) is the only truly effective long-term control for deer damage prevention. Fences can be electrified or not. Deer will try to go under a fence, through a fence, or over it. For non-electrified fences, the lowest wire needs to be within 10 inches or less of the lowest point in the ground around the fruit crop planting and tight enough to prevent deer from pushing under it. Do not neglect ditches or other low spots in the ground around the field, because the deer will find them. While some deer can easily clear an 8-foot fence, generally 6 feet will be sufficient to deter most deer. Wire mesh fences are more desirable than multiple strands of barbed wire. Wire mesh fence up to 5-feet high with the addition of 3 single strand wires for a total of 8 feet will reduce costs. Slant wire fence is another design - see paragraph below. Standard vertical fence with outriggers may be useful. Contact extension specialist for details on fence design.

For electric fences, several different designs have been used and, under certain conditions, each can be effective. The simplest and least expensive electric fence uses a single high-tensile wire at about 30 inches above ground level (approximately at the height of a deer's nose). A solar charger can be used if access to electricity is not an option. Peanut butter can either be smeared on the wire or on aluminum foil strips which are then draped over the wire. Plastic flagging may also be tied to the fence to make it more visible to the deer. Deer are curious animals and will investigate the fence if they are not being chased. Touching the fence results in getting shocked and turning the deer away from the field being protected. The single-wire, baited fence is relatively inexpensive, easy to construct and often adequate to protect the crop. With high deer populations, when available alternate food sources are scarce or when deer have already established a feeding pattern in the area being protected, this fence may not be adequate.

More substantial electric fences for deer control have multiple wires with the alternate wires being electrified. One design uses 5 wires and is constructed at a 45-degree angle facing away from the area to be protected. The bottom wire is within 10 inches of the ground and is electrified to keep deer from going under the fence. The middle wire is also electrified to prevent deer from going through the fence and the top wire, which may be only about 5 feet above ground is electrified to keep deer from going over the fence. A fence constructed in this manner presents a barrier to the deer that has height and depth, a combination that generally will discourage the deer from trying to enter the field. Poly Tape electric fences often used to contain cattle and horses, also works well as deer fences.

Numerous other fence designs exist including a non-electrified mesh fence with a hot wire on top. If electric fences are used, it is important to keep weeds, grasses, and other materials away from the fence to prevent it from shorting out and to increase its visibility. Contact your local county agent and/or state extension wildlife specialist for additional information.

Feral Swine

Feral swine (also known as wild pigs, wild boars, and razorbacks) are not native to North America. They were first brought by early explorers and settlers as a food source. In the 1900's, the Eurasian or Russian wild boar was introduced into parts of the U.S. for sport hunting. Today, feral swine are a combination of escaped domestic pigs, Eurasian wild boar, and hybrids of the two. They are dangerous, destructive, and considered to be the most threatening invasive species ever (USDA National Invasive Species Information Center).

Feral swine are one of the most widely ranging mammals in the world, found on every continent except Antarctica. In 1982, 18 U.S. states reported established feral swine populations. By 2016, this number had increased to 35 states. Current estimates are that over 9 million feral hogs exist in 38 states across the U.S., doing an estimated $2.5 billion in crop damage each year. In addition, feral pigs can host at least 30 viral and bacterial diseases and nearly 40 parasites.

Adult feral swine may weigh between 75 and 250 pounds on average, but some can get twice as large. They can reach 3 feet in height and up to 5 feet in length, with males (boars) being larger than females (sows). Feral swine are muscular and strong and can run up to 30 miles per hour for short distances. Both boars and sows can have tusks. Those of the boar can reach up to 5 to 18 inches in length while those of the sows are much smaller.

Feral swine populations have the potential to double in size over four months. Sows become sexually mature at 6 to 8 months. They can breed year-round and have two litters of four to eight piglets or more per litter.

Sows and their young travel in family groups called sounders, composed of two or more sows and their young. A sounder may range from a few individuals to as many as 30 members. Adult boars usually live alone or in bachelor groups and only join a sounder to breed. Feral swine occupy a home range of between 0.5 and 3 square miles, depending on population and the availability of food sources.

Feral swine are usually more active at night, especially in hot, humid climates. Therefore, it may be easier to identify their presence based on signs of damage rather than sightings of the hogs. They cause damage by consuming crops, rubbing on trees and vines, scraping them with their tusks, rooting, establishing wallows, tearing up irrigation lines, and punching holes in plastic row covers.

Long-term control of swine populations may be achieved only if adjacent property owners work together and if multiple management strategies are used in unison. Currently, no toxicants or oral contraceptives are approved for use in the U.S. and no effective repellents have been identified. Non-lethal techniques such as exclusion may be effective in limiting crop damage.

Lethal techniques offer more promise in limiting population growth and achieving long-term suppression of damage. For many states, there is no season for hunting feral swine so they may be taken throughout the year. Hunting, while commonly used for control, offers both good and bad results. While some feral swine may be harvested, those remaining will become even more elusive, making control more difficult. Trapping is the most successful control method. Trapped hogs should be shot on sight. Transporting live hogs is illegal. The earlier feral hogs are identified in an area, the easier it will be to eradicate them.

Before starting any control program, it is important to check federal, state, and local laws and regulations regarding hunting, the use of firearms, traps, and snares. For more information and help, contact APHIS Wildlife Services at 1-866-4-USDA-WS (1-866-487-3297), or use the Wildlife Service's program directory to contact your local program or connect with your local Extension agency, wildlife agency, or other professional in your area.

For more information, see the USDA publication "Fencing Out Feral Swine," available at https://www.aphis.usda.gov/sites/default/file/fencing-out-feral-swine-infosheet.pdf.

Black Bears

Bears can damage strawberry fields by eating the fruit and tearing up the plastic on raised beds in plasticulture fields. Although strawberries are self-fertile, they rely on insects (primarily honeybees) and wind to transfer pollen on the flower. If growers bring in, or have their own hives, this is where the threat from bears might be greatest.

Black bears are considered a game species in most states and protected in others. Thus, some states may only allow nonlethal or less-than-lethal methods of management. Also, lethal control is only available during legal hunting seasons and in following state-specific regulations. States may provide additional options for reducing agricultural depredation (e.g., lethal control, trap and relocate) so you can check your state wildlife agency for details.

Deterrents

Hazing black bears can temporarily deter bears from accessing fruit crops. Deterrents include motion-activated sprinklers or alarms, but these may be generally ineffective once bears have successfully accessed the fruit crop. Bears will also become quickly desensitized to these deterrents.

Exclusion

Electric fencing is the only effective long-term control method for preventing black bear damage, but it can be cost-prohibitive for protecting large areas. To successfully deter bears, the power source needs to deliver 45 – 60 electric pulses per minute. They also need to deliver enough energy to sufficiently shock the animal. Current research recommends approximately 5,000 to 6,000 volts are needed to effectively shock a bear. At least 5 electrified wires are recommended with the lowest wire placed at 8" aboveground, and additional wires being placed at 8" intervals so that a bear cannot pass through or go over without touching at least one electric line. Gates into the fenced area must also be electrified or else bears will quickly find this location to access the fruit crop. Prefabricated electrified netting fences may be used for quick and easy temporary fences. See bearwise.org for specific guidance on fencing.

Voles

Voles cause problems in strawberry fields by feeding on the roots and crowns of plants and by chewing holes in irrigation tapes under the plastic cover of raised beds. There are no rodenticides labeled for use in strawberries. However, practices utilized in preparing fields for plasticulture strawberries should rid the area of any resident vole populations. Therefore, vole control for these fields needs to focus primarily on preventing reinfestation from adjacent areas. Habitat modification practices such as cleaning up nearby fencerows, ditch banks and hedgerows, along with frequent, close mowing of vegetation surrounding the fields, will discourage vole presence as a result of increased exposure to predators. Maintaining a barrier of very closely mowed vegetation around the perimeter is one option. Another option is to maintain a bare-soil perimeter around the fruit crop if that can be done without increasing erosion risks. Seasonal disking or herbicide treatment can maintain bare-soil perimeter seasonally.

Rabbits and Other Wildlife

Rabbits can devastate crops and can occur in high densities. Some products are sold as rabbit repellents, but the efficiacy is largely untested. Fencing, mesh, or chicken wire may be the most effective solution. Bury the fence 6-8 inches below ground and extend to a height of 2 ½ feet. Secure at 6- to 8-foot intervals with sturdy stakes (wood, metal, or fiberglass). Coyotes may take strawberries, and armadillos may dig up plants as they forage for insects, ants, earthworms, and other food items. Fencing will aid in control of numerous small wildlife pests. Lethal control may be necessary. Consult your state wildlife resource department for lethal control options. Trapping is difficult, especially for coyotes and armadillos.

DISEASE PHOTOS

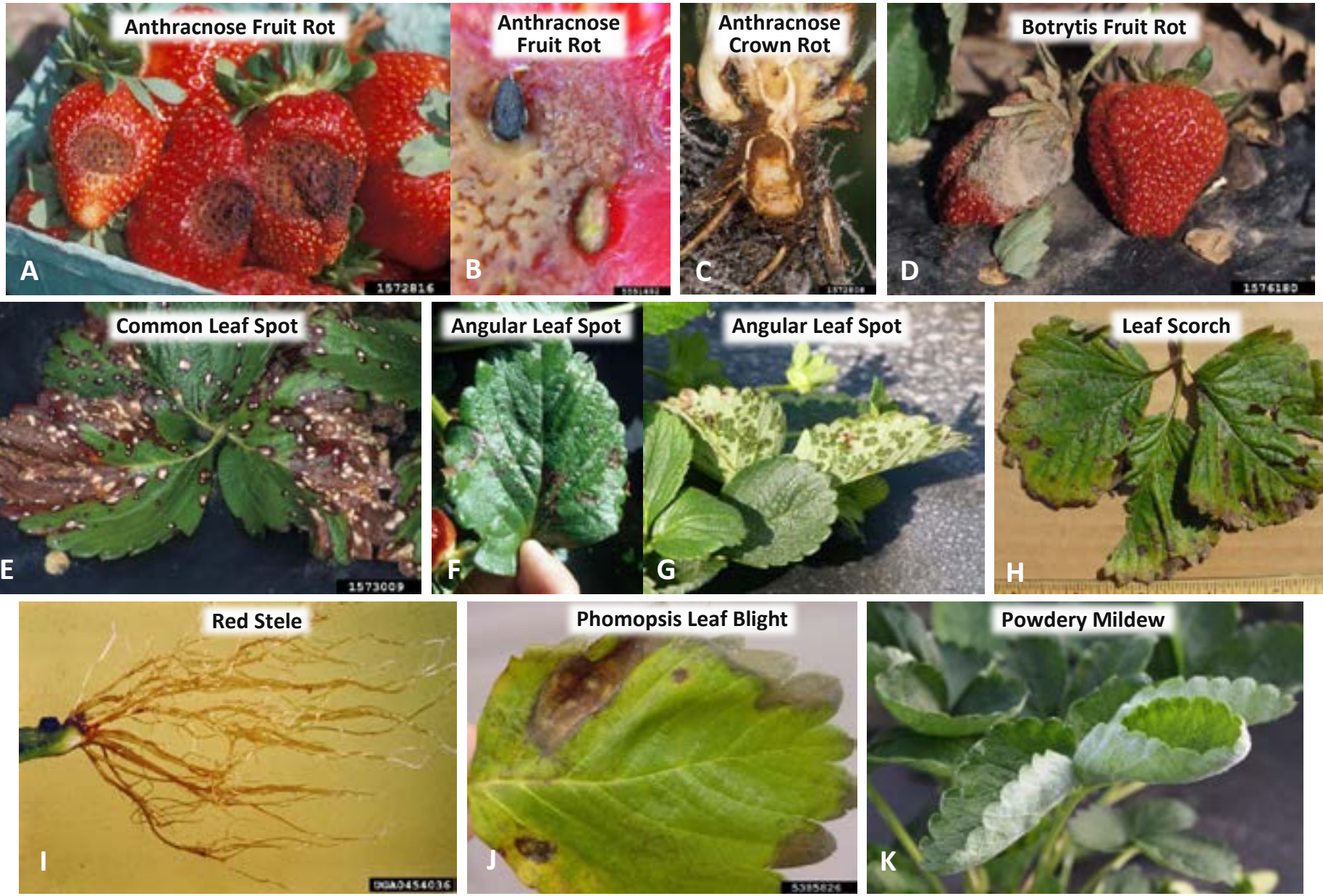


Photo Credits: (A, C, D, E) G. Holmes, Strawberry Center, Cal Poly San Luis Obispo, Bugwood.org; (B) R. A. Melanson, Mississippi State University Extension, Bugwood.org; (F) E. Sikora, Auburn University, Bugwood.org; (G) D. Ferrin, LSU AgCenter, Bugwood.org; (H, J) P. Bachi, University of Kentucky Research and Education Center, Bugwood.org; (I) SCRI-Dundee, Scottish Crop Research Institure, Bugwood.org; (K) N. Peres, University of Florida – IFAS.

DISEASE PHOTOS (CONTINUED)

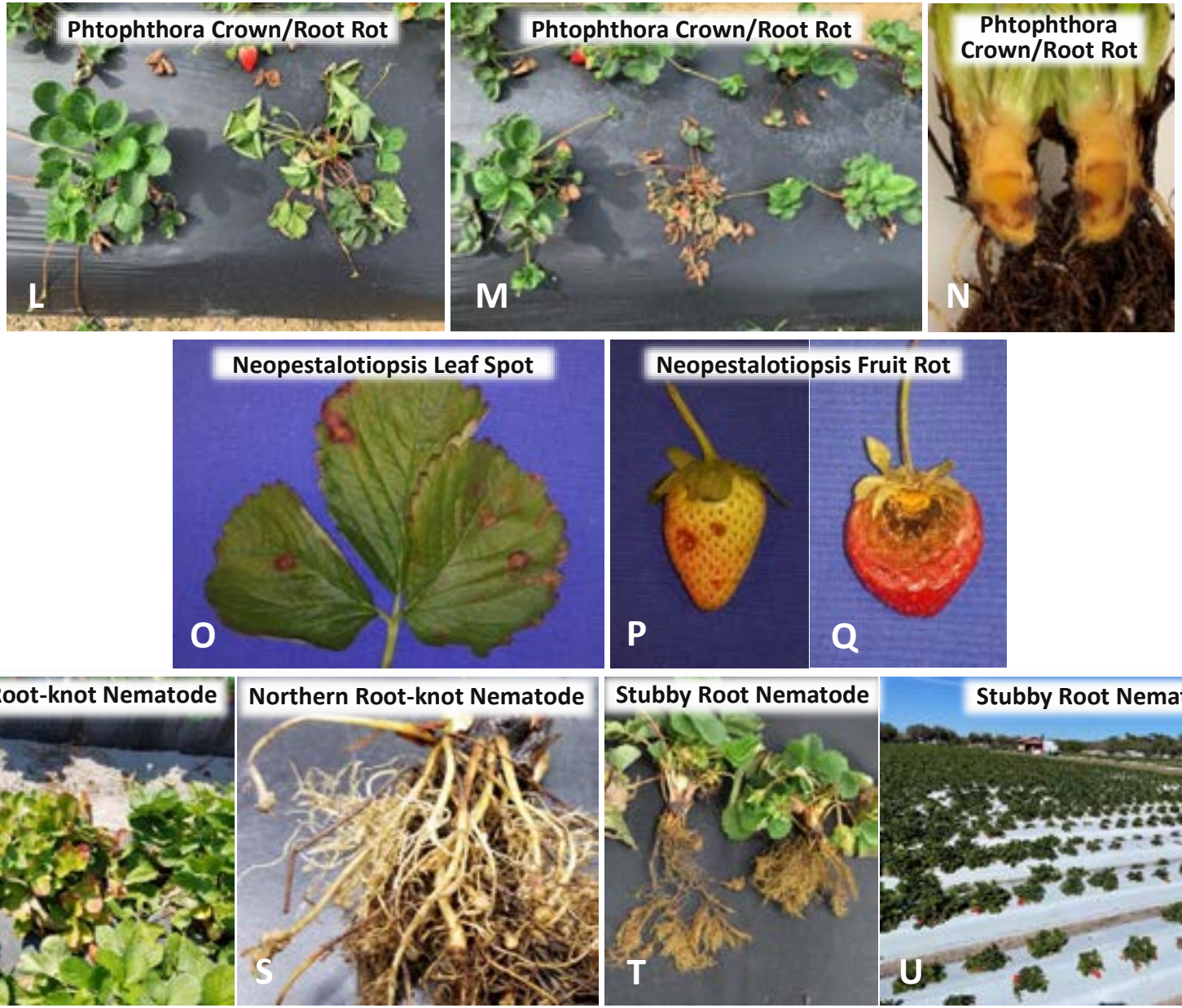
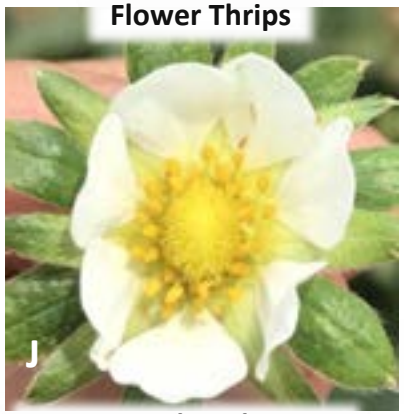


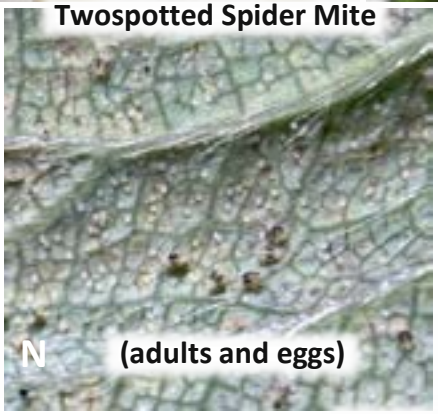
Photo Credits: (L, M, N) R. Singh, LSU AgCenter; (O, P, Q) N. Peres, University of Florida – IFAS; (R, S, T, U) J. Desaeger, University of Florida – IFAS.

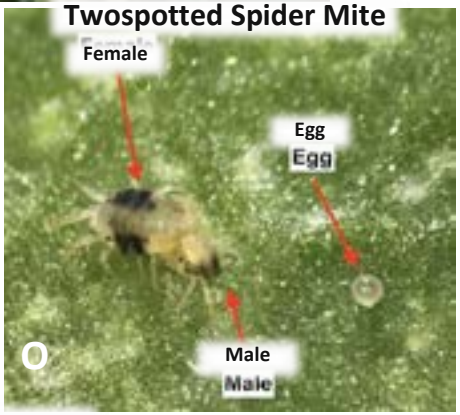
ARTHROPOD PHOTOS

Photo Credits: (A, B, D, E, F, G, H) H. Burrack, North Carolina State University; (C) H. Burrack, North Carolina State University, Bugwood.org; (I) J. W. Lotz, Florida Department of Agriculture and Consumer Services, Bugwood.org.

ARTHROPOD PHOTOS (CONTINUED)







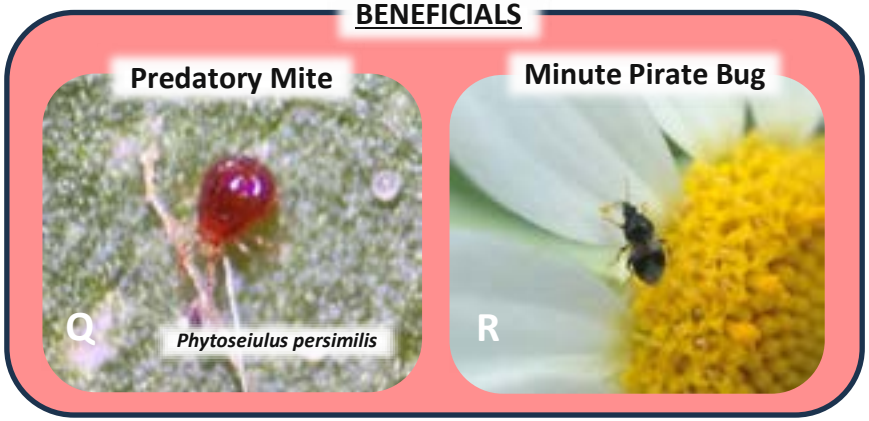


Photo Credits: (J-R) T. Bilbo, Clemson University.

WEED PHOTOS

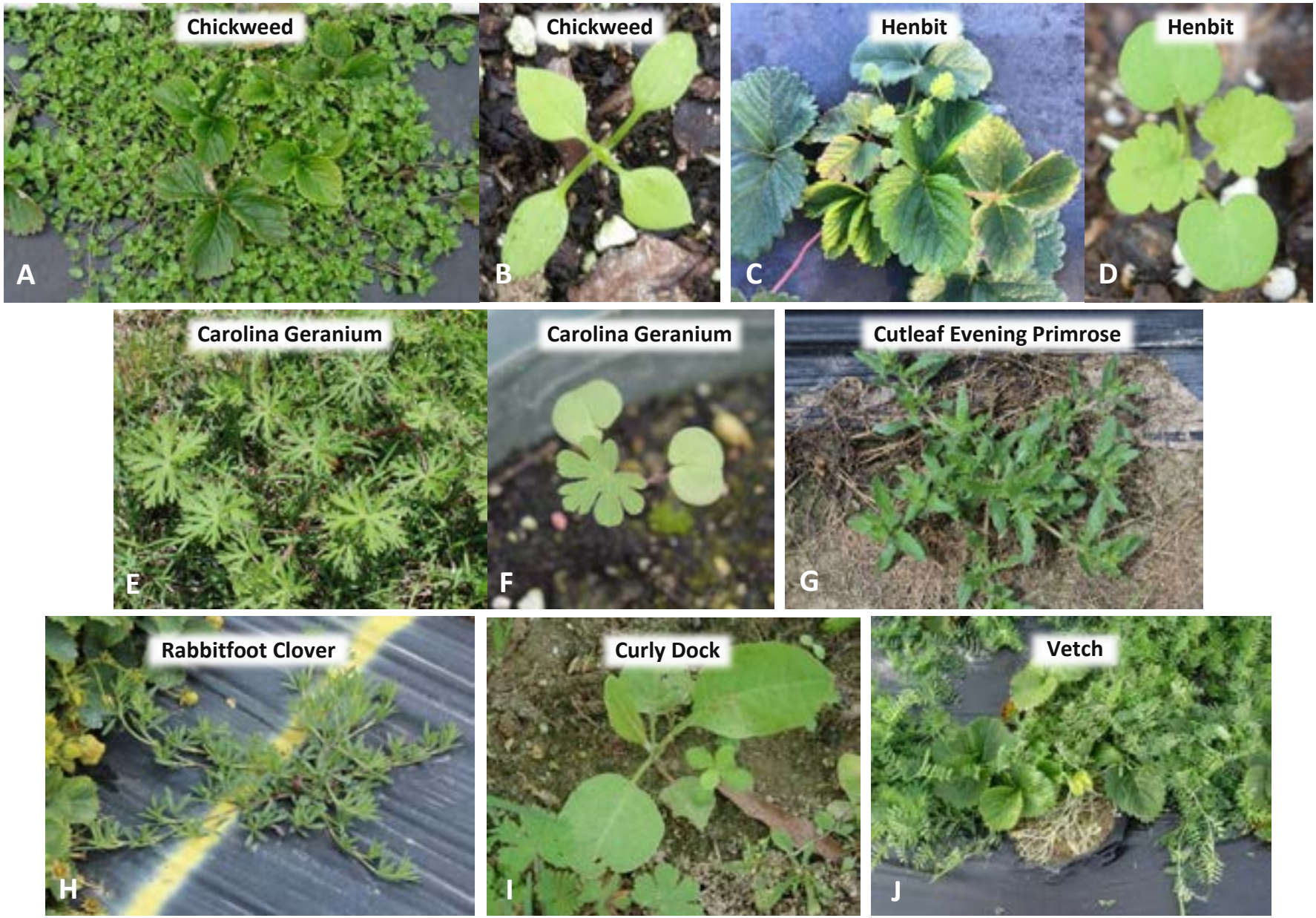


Photo Credits: (A, B, C, D, I, J) K. Jennings, North Carolina State University; (E, G, H) K. Sims, North Carolina State University; (F) C. Veazie, North Carolina State University.

USER NOTES

USER NOTES

USER NOTES

USER NOTES

USER NOTES

UNIVERSITY OF GEORGIA
EXTENSION

The permalink for this UGA Extension publication is fieldreport.caes.uga.edu/publications/AP119-7

Annual Publication 119-7 **April 2026**

Published by University of Georgia Cooperative Extension. For more information or guidance, contact your local Extension office.