

# **2017 Southeast Regional Strawberry Integrated Pest Management Guide**

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Recommendations are based on information from the manufacturer's label and performance data from research and Extension field tests.


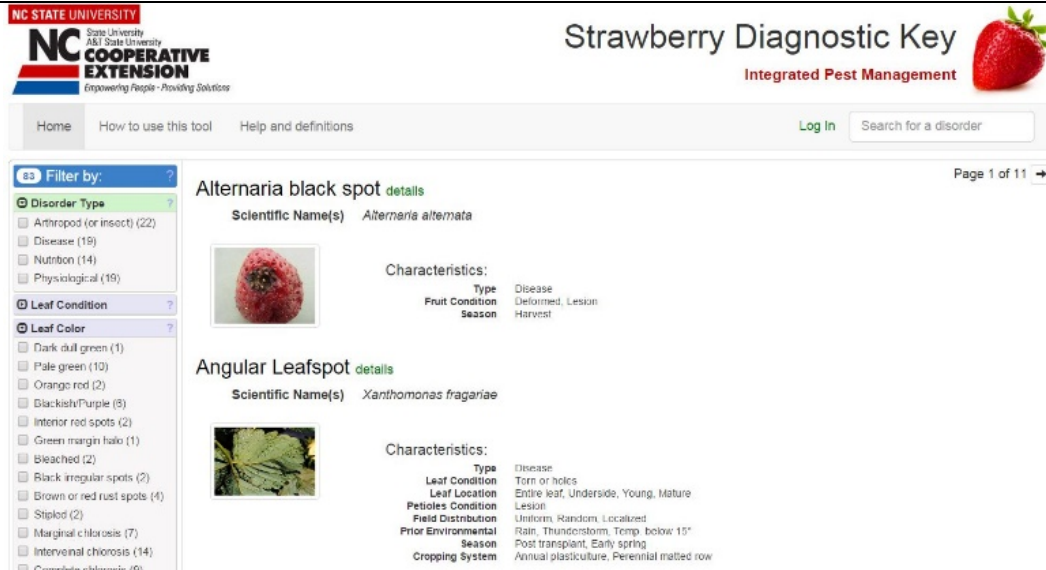
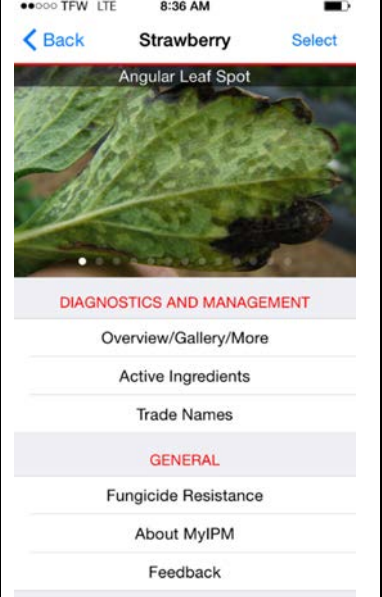
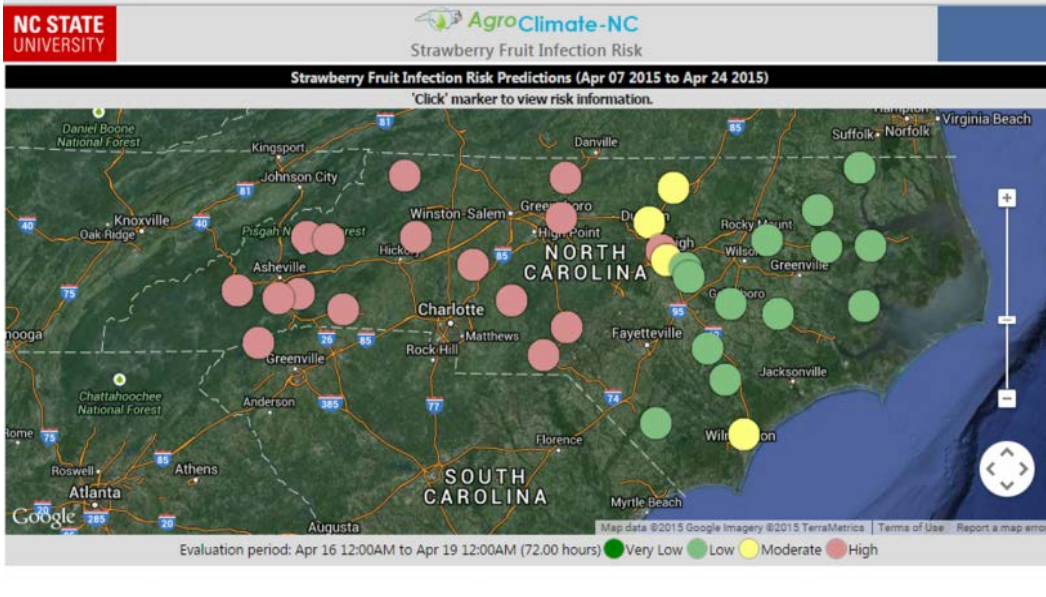
Because environmental conditions and grower application methods vary widely, suggested use does not imply that performance of the pesticide will always conform to the safety and pest control standards indicated by experimental data.

This publication is intended for use only as a guide. Specific rates and application methods are on the pesticide label, and these are subject to change at any time. Always refer to and read the pesticide label before making any application! The pesticide label supersedes any information contained in this guide, and it is the legal document referenced for application standards.

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## MyIPM app and Online Tools

<p><b>MyIPM</b> a smart phone app contains useful strawberry disease information in support of this IPM guide Download for FREE in Apple's App Store or Google's Play Store.</p> 	 <p><b>Strawberry Diagnostic Key</b> Integrated Pest Management</p> <p>Home How to use this tool Help and definitions Log In Search for a disorder</p> <p>Filter by: ?</p> <ul style="list-style-type: none"> <li>Disorder Type       <ul style="list-style-type: none"> <li>Anthropod (or insect) (22)</li> <li>Disease (19)</li> <li>Nutrition (14)</li> <li>Physiological (19)</li> </ul> </li> <li>Leaf Condition ?</li> <li>Leaf Color ?       <ul style="list-style-type: none"> <li>Dark dull green (1)</li> <li>Pale green (10)</li> <li>Orange red (2)</li> <li>Blackish/Purple (3)</li> <li>Interior red spots (2)</li> <li>Green margin halo (1)</li> <li>Bleached (2)</li> <li>Black irregular spots (2)</li> <li>Brown or red rust spots (4)</li> <li>Stippled (2)</li> <li>Marginal chlorosis (7)</li> <li>Interveinal chlorosis (14)</li> <li>Complete chlorosis (6)</li> </ul> </li> </ul> <p><b>Alternaria black spot details</b> Scientific Name(s) <i>Alternaria alternata</i></p> <p><b>Angular Leafspot details</b> Scientific Name(s) <i>Xanthomonas fragariae</i></p>	<p><b>Strawberry Diagnostic Key</b></p> <p>includes insects, diseases, nutritional deficiencies and physiological disorders.</p> <p>Available online at <a href="http://diagnosis.ces.ncsu.edu/strawberry/">diagnosis.ces.ncsu.edu/strawberry/</a></p>
 <p>TFW LTE 8:36 AM</p> <p>Back Strawberry Select</p> <p>Angular Leaf Spot</p> <p>DIAGNOSTICS AND MANAGEMENT</p> <ul style="list-style-type: none"> <li>Overview/Gallery/More</li> <li>Active Ingredients</li> <li>Trade Names</li> </ul> <p>GENERAL</p> <ul style="list-style-type: none"> <li>Fungicide Resistance</li> <li>About MyIPM</li> <li>Feedback</li> </ul>	 <p><b>AgroClimate-NC</b> Strawberry Fruit Infection Risk</p> <p>Strawberry Fruit Infection Risk Predictions (Apr 07 2015 to Apr 24 2015) 'Click' marker to view risk information.</p> <p>Evaluation period: Apr 16 12:00AM to Apr 19 12:00AM (72.00 hours)</p> <p>Very Low Low Moderate High</p>	<p><b>Strawberry Fruit Infection Risk</b></p> <p>weather-based decision support systems to optimize spray timing for Botrytis and Anthracnose fruit rots are available for North Carolina</p> <p>Visit the Strawberry Advisory System</p> <p><a href="https://ipm.ces.ncsu.edu/strawberry-fruit-infection-risk-tool/">https://ipm.ces.ncsu.edu/strawberry-fruit-infection-risk-tool/</a></p>

## General Pesticide Information

**FRAC/IRAC/HRAC codes** — these acronyms refer to industry-sponsored committees addressing resistance to crop protection materials; **Fungicide Resistance Action Committee (FRAC)**, **Insecticides Resistance Action Committee (IRAC)** and **Herbicide Resistance Action Committee (HRAC)**. Pesticides affect their target pest 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 FRAC/IRAC/HRAC have grouped crop protection materials into groups with shared MOAs and given them numerical designations, which appear on pesticide labels. The code **UN** means the MOA is unknown. *When selecting pesticides, avoid successive applications of materials in the same MOA group to minimize potential resistance development.* More information about this topic can be found at [www.frac.info](http://www.frac.info), [www.irac-online.org](http://www.irac-online.org), and [www.HRACglobal.com](http://www.HRACglobal.com)

**Organic Materials Review Institute (OMRI; [www.omri.org](http://www.omri.org)) listed materials are acceptable for production systems certified as organic.** Organically acceptable materials (OMRI listed) are in the Comments section.

**Generics:** Many pesticide active ingredients are available in generic formulations. For brevity, these formulations are not generally listed. Trade names are listed to aid in identifying products and not intended to promote the use of these products or to discourage 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.

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

## Seasonal “At-a-Glance” Arthropod Guide<sup>1</sup>

Developmental Stage	Post-planting (Fall/early to mid-winter)	Pre-harvest — Bloom (Late winter to early spring) <sup>3</sup>	Harvest
<b>Pests potentially present (Insecticides/ Miticides)</b>	Crickets (carbaryl, malathion) Cutworms (carbaryl, Coragen, Entrust, malathion, <i>Bt</i> , Intrepid) Cyclamen mites (Portal, imidacloprid) Twospotted spider mites: <sup>2</sup> <ol style="list-style-type: none"> <li>1. (Acramite, Kanemite, Oberon, Savey, Zeal, Portal);</li> <li>2. (Agri-Mek, Vendex);</li> <li>3. (M-Pede, horticultural oils);</li> <li>4. predatory mites</li> </ol>	Aphids <sup>3</sup> (malathion, Sivanto, imidacloprid, Platinum, insecticidal soap) Fire ants <sup>4</sup> (Extinguish or Esteem Ant Baits) Flower thrips <sup>3</sup> (Entrust, Radiant) Slugs/snails (baits containing carbaryl, metaldehyde, and/or iron phosphate) Strawberry clippers (Brigade, Danitol, carbaryl) Twospotted spider mites: <sup>6</sup> <ol style="list-style-type: none"> <li>1. (Acramite, Kanemite, Oberon, Savey, Zeal, Portal);</li> <li>2. (Agri-Mek, Vendex);</li> <li>3. (M-Pede, horticultural oils);</li> <li>4. predatory mites</li> </ol>	Fire ants <sup>4</sup> (Extinguish, Esteem) Sap beetles <sup>7</sup> (cultural control, Rimon) Slugs/snails (baits containing carbaryl, metaldehyde, or iron phosphate) Spotted wing drosophila (Brigade, Danitol, Entrust, Malathion and generics, Radiant) Tarnished plant bugs <sup>5</sup> (Brigade, Danitol, Rimon) Twospotted spider mites: <sup>6</sup> <ol style="list-style-type: none"> <li>1. (Acramite, Kanemite, Oberon, Savey, Zeal, Portal);</li> <li>2. (Agri-Mek, Vendex);</li> <li>3. (M-Pede, horticultural oils)</li> <li>4. predatory mites</li> </ol> Whiteflies (Oberon, Rimon)

<sup>1</sup> 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.

<sup>2</sup> 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 the first group are effective against eggs as well as older life stages of the twospotted spider mite; these materials are the primary tools for spring infestations. Fall use could affect the number of applications allowed in the spring. The second group of materials are effective only against adult mites. The third group of materials is organically acceptable (**OMRI** listed) and effective only against adults; coverage is very important to the efficacy of these materials. Resistance management is crucial for all miticides. Rotate to a new mode of action (MOA) if more than one treatment is necessary (see tables for Modes of Action). Follow resistance management guidelines on labels. Native predatory mites may be effective. They may be augmented with mites from commercial sources. Carbaryl and pyrethroids are highly toxic to predatory mites.

<sup>3</sup> Aphid or flower thrips 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.

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

<sup>5</sup> Tarnished plant bugs can feed early in the spring on flowers and developing weed seeds. Wild radish, often called wild mustard, is a favored late winter host. Reducing weeds in and around fields will reduce populations. See note above about honey bees

<sup>6</sup> As weather begins to warm, scout regularly for mites. Follow label instructions about resistance management carefully when using miticides.

<sup>7</sup> Sap beetles are attracted to overripe fruit. Keeping fruit picked and removed from the field will reduce problems with sap beetles.

## Pre-planting: Disease and Weed Management

Pest/Problem	Management Options	Effectiveness (+) or Importance (*)	Comments
Anthracnose Angular leaf spot Phytophthora crown rot Fusarium wilt (not reported in Eastern U.S.) Viruses	Disease free plants	***** +++++	Use of certified plants or plants produced in a similarly stringent program is the most important method to prevent these diseases.
Nematodes	Sample soil	***	Sample soils for nematode analysis through local state services to determine which fumigant or IPM management plan may be required.
Nematodes and soilborne pathogens (Pythium, Phytophthora, Fusarium, Rhizoctonia)	Crop rotation and cover crop selection	*** +++	Selected summer cover crops and rotating fields to other crops for 2 to 3 years can suppress nematode populations and reduce black root rot and other disease problems.
Weeds Root and crown rot disorders Nematodes (Black root rot; Phytophthora crown rot)	Pre-plant fumigation and laying down plastic mulch	+++++	See fumigation table below. Consult with custom applicators and/or Extension agents for product and rate recommendations.

**Pre-plant dips:** Several products are registered for 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.

**Abund or Azaka**— 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 bacterial angular 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, and it is doubtful that a root dip would offer much benefit for season long control. Growers must ensure root dip waste is properly disposed.

**Switch** — Switch offers options for treating plants known to be infected with *Colletotrichum* species 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 treated plants as quickly as possible. Delayed planting could cause plant stunting.

**Phosphites** — Dip plants in 2.5 lb/100 gal (Aliette), 2 pints/100 gal (ProPhyt), or 2.5 pints/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 (+) or Importance (*)	REI	PHI	Comments
Nematodes	Nimitz or Fluensulfone 480EC	3.5 - 7 pt per treated acre	See comments	0 hr	0 days	Nimitz is a “traditional contact 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; only 1 application per year. Soil temperature must be 60° or above. Soil incorporation in the top 6-8 inches is critical. Irrigating (0.5-1 inches) 2-5 days after application is recommended.
	Majestene (heat-killed <i>Burkholderia</i> spp. strain A396)	4 – 8 qt (8 – 16 pt or 1-2 gal)	See comments	4 hr	0 days	Majestene 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 root-knot, lesion, sting, stunt, ring, and reniform nematodes. Can be applied as a pre-plant incorporated, in-furrow or banded spray as long as spray volume is sufficient to thoroughly soak the root zone. However, Majestene can also be drip-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, another product may also be necessary for control.

**Fumigants:** New 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 see <http://www2.epa.gov/soil-fumigants>. Some fumigants are registered on multiple crops but with crop- or soil-type -specific rates; others are registered for specific crops and/or in certain states only. Follow all labels carefully.

<b>Relative Efficacy: Currently Registered Fumigants or Fumigant Combinations for Managing Soilborne Nematodes, Diseases, and Weeds in Plasticsulture Strawberries<sup>1</sup></b>						
<b>Product</b>	<b>Rate per Treated Acre<sup>2</sup></b>		<b>Nematodes</b>	<b>Disease</b>	<b>Nutsedge</b>	<b>Weeds: Annual</b>
	<b>Volume (gal)</b>	<b>Weight (lb)</b>				
Telone II (1,3-D)	15-27	153-275	+++++	+	-	-
Telone EC <sup>3</sup>	9-24 <sup>4</sup>	91-242 <sup>4</sup>	+++++	+	-	-
Telone C17 (1,3-D + chloropicrin)	32.4-42	343-445	+++++	+++	+	+
Telone C35 (1,3-D + chloropicrin)	39-50	437-560	+++++	+++++	+	++
InLine (1,3-D + chloropicrin) <sup>3</sup>	29-57.6 ( <i>See Label</i> )	325-645 ( <i>See Label</i> )	+++++	+++++	+	+++
Pic-Clor 60 (chloropicrin + 1,3-D)	48.6	588	+++++	+++++	+	+++
Pic-Clor 60 EC <sup>3</sup>	42.6	503	+++++	+++++	+	+++
Metam potassium <sup>5</sup>	30-62	318-657	++	+++	+	++++
Metam sodium <sup>5</sup> (MS)	37.5-75	379-758	++	+++	+	++++
Chloropicrin + MS <sup>5</sup>	19.5-31.5 + 37.5-75	275-444 + 379-758	++	+++++	++	++++
Chloropicrin	48.6	150-350	+	+++++	—	—
Tri-Pic 100EC <sup>3</sup>	8-24	100-300	+	+++++	—	—
Paladin (dimethyl disulphide) <sup>6</sup>	35.0-51.3	310-455	++++	++++	++++	+++ <sup>5</sup>
Paladin EC <sup>3,6</sup>	37.0-54.2	326-479	++++	++++	++++	+++ <sup>5</sup>
Dominus (allyl isothiocyanate) <sup>7</sup>	25-40 <sup>4</sup>	212-340 <sup>4</sup>	++	+++	+	+++

SEE FOOTNOTES ON NEXT PAGE



<sup>1</sup> 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 or Paladin. 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.

<sup>2</sup> Rates can sometimes be reduced if products are applied with VIF or TIF.

<sup>3</sup> 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.

<sup>4</sup> Labelled rates are per *broadcast-equivalent* acre, NOT per treated acre.

<sup>5</sup> 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.

<sup>6</sup> Paladin should be applied with 21% chloropicrin and VIF or TIF to enhance disease control, and has low efficacy on certain small seeded broadleaf weeds and grasses. Paladin may not be registered in all States.

<sup>7</sup> 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.

## Fungicide Resistance Management Recommendations

*Botrytis cinerea* 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. Limit the number of times fungicides of the same class (same FRAC code) are applied in 1 year.
2. Tank-mix a broad spectrum fungicide such as **captan or Thiram with Topsin-M (a benzimidazole fungicide) as Topsin-M does no longer have Botrytis activity due to resistance, but is helpful for several early season foliar diseases if present.**
3. Resistance profiles vary from farm-to-farm. Sample gray mold populations for their resistance profile through Clemson University (schnabe@clemson.edu)

**It is currently suggested that the strobilurin (now called QoI; FRAC code 11) fungicides (Abound, Azaka, Cabrio, Pristine, Merivon, and Quadris Top) be saved for use in controlling anthracnose diseases 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 materials are currently the most efficacious materials for control of anthracnose.** Some of these QoI materials 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 QoIs 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 QoIs; make sure to follow all resistance management guidelines. Recently, we have documented reduced activity with azoxystrobin (Abound, Azaka) with certain strains of the anthracnose fruit rot (AFR) pathogen. Cabrio, Merivon, or Pristine have offered better control of AFR in recent research efforts.

**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. **Certain fungicides such as the QoI materials and Protocol are registered for powdery mildew, but are not recommended due to resistance selection.**

**Anthracnose** — Most plantings are rarely at risk for anthracnose. Thus, anthracnose fungicides may not be needed. In most cases, contaminated plant sources are identified before or soon after planting. Know your plant source. 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 ('*acutatum*') compared to the crown rot pathogen ('*gloeosporioides*'). Captan, Topsin M or Switch are as effective as the QoIs for controlling the crown rot pathogen.** In general, it is most effective to save the QoI (Group 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 with Abound or similar azoxystrobin products (see above).

Planting and Early Post-planting: Disease Management						
Pest/Problem	Management Options	Amount of Formulation per Acre	Effectiveness (+) or Importance (*)	REI	PHI	Comments (FRAC/IRAC Code)
Red stele; <i>Phytophthora</i> crown/root rots	mefenoxam (Ridomil Gold SL)	1 pt	++++	12 hr	0 days	Apply in sufficient water in drip applications to move the fungicide into the root zone. Use proportionately less Ridomil Gold for band treatments. <b>Do not exceed 3 pts/year. FRAC-4</b>
	mefenoxam (Ultra Flourish)	2 pt	++++	12 hr	0 days	Apply in sufficient water to move the fungicide into the root zone. Use proportionately less mefenoxam for band treatments. <b>Do not exceed 6 pts/year. FRAC-4</b>
	metalaxyl (MetaStar and generics)	2 qt/treated A	++++	48 hr	0 days	Apply in sufficient water to move the fungicide into the root zone. <b>Do not exceed 6 qt/treated A/year. FRAC-4</b>
	phosphites, e.g. Aliette ProPhyt, Phostrol	Various rates; see label	++	12 hr	0 days	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. <b>FRAC-33</b>
<i>Rhizoctonia</i> sp.(seedling root; basal stem rot)	Abound FL, Azaka	0.40 to 0.80 fl oz/1,000 row feet	++	4 hr	0 days	This is a drip irrigation application method. Can be considered especially for plug plants with poor root systems or plants placed into non-fumigated beds or beds with excess water in heavy soils. <b>FRAC-11</b>
Powdery mildew only	PM is not a common problem at this time of year; PM may come on transplants but usually does not persist nor does it present an economic problem in open fields. There is more risk of PM in high tunnels.					
	Procure 50WS	4 to 8 oz	+++++	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 application. <b>FRAC-3</b>
	Procure 480SC	4 to 8 fl oz				
	Rally 40WSP	2.5 to 5 oz	+++++	24 hr	0 days	Rally is registered for control of leaf spot, leaf blight, and powdery mildew. <b>FRAC-3</b>
	Sulfur (multiple formulations)	5 to 10 lb	+++	24 hr	1 day	Spray as needed. Avoid using in middle of a hot sunny day that may cause leaf burning. See label. <b>FRAC-M2</b>
	Quintec	4 to 6 fl oz	+++++	24 hr	1 day	Do not use more than 4 times per crop and no more than 2 times in a row. Rotate with other mildewcides. For food and feed crops not registered on the label, the re-plant interval is 30 days after application. See label. <b>FRAC-13</b>
	Protocol	1.33 pt	+++	24 hr	1 day	Premix of two active ingredients, thiophanate-methyl ( <b>FRAC-1</b> ) and propiconazole ( <b>FRAC-3</b> ). No more than 2 sequential applications should be made before alternating with fungicides that have a different mode of action.

## Planting and Early Post-planting: Disease Management

Pest/Problem	Management Options	Amount of Formulation per Acre	Effectiveness (+) or Importance (*)	REI	PHI	Comments (FRAC/IRAC Code)
Anthracnose ('acutatum')	Pristine WG	18.5 to 23 oz	+++++	12 hr	0 days	Premix of two active ingredients, pyraclostrobin ( <b>FRAC-11</b> ) and boscalid ( <b>FRAC-7</b> ). See resistance management notes on page 22.
	Merivon	5.5 to 8 fl oz	+++++	12 hr	0 days	Premix of two active ingredients, pyraclostrobin ( <b>FRAC-11</b> ) and fluxapyroxad ( <b>FRAC-7</b> ). See resistance management notes on page 22.
	Luna Sensation	4.0 to 7.6 fl oz	+++++	12 hr	0 days	Premix of two active ingredients, trifloxystrobin ( <b>FRAC-11</b> ) and fluopyram ( <b>FRAC-7</b> ). See resistance management notes on page 22.
	Cabrio 20EG	12 to 14 oz	+++++	24 hr	0 days	Active ingredient, Pyraclostrobin ( <b>FRAC-11</b> )
	Abound FL, Azaka	6.2 to 15.4 fl oz	+++++	4 hr	0 days	Failure in management of some 'acutatum' populations has been observed with Abound and similar products. <b>FRAC-11</b>
	Tilt and multiple generics	4 fl oz	+++	12 hr	0 days	No more than 2 sequential applications should be made before alternating with fungicides that have a different mode of action. <b>FRAC-3</b>
	Quadris Top	12 to 14 fl oz	+++	12 hr	0 days	Premix of two active ingredients, azoxystrobin ( <b>FRAC-11</b> ) and difenoconazole ( <b>FRAC-3</b> ). No more than 2 sequential applications should be made before alternating with fungicides that have a different mode of action.
	Protocol	1.33 pt	+++	24 hr	1 day	Premix of two active ingredients, thiophanate-methyl ( <b>FRAC-1</b> ) and propiconazole ( <b>FRAC-3</b> ). No more than 2 sequential applications should be made before alternating with fungicides that have a different mode of action.
Anthracnose ('gloeosporioides' crown rot)	Captan 50W	3 to 6 lb (50W)	++	24 hr	1 day	In plantings known to be infected with the anthracnose crown rot pathogen, consider applying captan plus Topsin-M at 10- to 14-day intervals, for a total of 2 to 3 applications in the fall. <b>FRAC-M4</b>
	Captan 80WDG	1.9-3.8 lb (80W)				
	Captec 4L	2.5 qt	++	24 hr	1 day	<b>FRAC-M4</b>
	Topsin-M 70WP	1 lb	++	12 hr	1 day	See note (page 22) on resistance management. <b>FRAC-1</b>
	Quadris Top	12 to 14 fl oz	+++	12 hr	0 days	Same as above. <b>FRAC-3, FRAC-11</b>

## Post-planting: Insect Management

Pest/Problem	Management Options	Amount of Formulation per Acre	Effectiveness (+) or Importance (*)	REI	PHI	Comments (FRAC/IRAC Code)
Crickets	Crickets are an infrequent problem in strawberries and rarely require management.					
	carbaryl Sevin 80 S, WSP Sevin 50 WP Sevin 4 XLR	2.5 lb 4 lb 1 to 2 qt	++	12 hr	7 days	Repeated use of carbaryl may flare spider mite populations. DO NOT apply when bees are foraging. <b>IRAC-1A</b>
	malathion (several products) 57 EC	1.5 to 3 pt	+	12 hr	3 days	Apply when damage is first noted. DO NOT apply when bees are foraging. <b>IRAC-1B</b>
Cutworms	Cutworms are usually more of a problem in matted-row culture or weedy plantings. Scout for cutworm damage and presence after transplant.					
	<i>Bacillus thuringiensis</i> (Bt) (many products)	Rates vary	++			Many Bt formulations are <b>OMRI</b> listed. <b>IRAC-11B2.</b>
	carbaryl (Sevin 80 S, WSP 50 WP 4 XLR)	2.5 lb 4 lb 1 to 2 qt	++	12 hr	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. <b>IRAC-1A</b>
	chlorantraniliprole (Coragen)	3.5 to 7.5 fl oz	++++	4 hr	1 day	<b>IRAC-28</b>
	malathion malathion 8 Flowable	1.5 to 2 pt	++	12 hr	3 days	Malathion 8 Flowable can be applied via drip lines, allowing treatment under plastic if cutworms are present. <b>IRAC-1B</b>
	methoxyfenozide (Intrepid)	6 to 12 fl oz	+++	4 hr	3 days	<b>IRAC-18</b>
	spinosad (Entrust 80W)	1 to 1.25 oz	+++	4 hr	1 day	Rotate to a different class of insect control products after 2 successive applications of spinosad. Do not make more than 5 applications per year. Do not apply more than 9 oz of Entrust (0.45 AI of spinosad) per acre per crop. Entrust is <b>OMRI</b> listed. <b>IRAC-5</b>
Cyclamen mites	fenpyroximate (Portal)	2 pt	Unknown	12 hr	1 day	Limited data on Portal is available in the southeast. <b>IRAC-21A</b>
	imidacloprid (Admire Pro 4.6 F)	10.5 to 14 oz	+++	12 hr	14 days	Apply in transplant water or through irrigation. DO NOT apply when bees are foraging or within 10 days of bloom. <b>IRAC-4A</b>
Strawberry clippers	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 WSB)	6.4 to 32 oz	+++	12 hr	0 days	DO NOT apply when bees are foraging. <b>IRAC-3</b>

Post-planting: Insect Management						
Pest/Problem	Management Options	Amount of Formulation per Acre	Effectiveness (+) or Importance (*)	REI	PHI	Comments (FRAC/IRAC Code)
Strawberry clippers (continued)	carbaryl (Sevin XLR)	1 to 2 qt	++	12 hr	1 day	If carbaryl is your material of choice for strawberry clippers, Sevin XLR will have a lower impact on bees. Apply material at dusk when bees are not foraging, and allow the maximum amount of dry time before bees become active. <b>IRAC-1A</b>
	fenprothrin (Danitol 2.4 EC)	16 to 21.33 fl oz	+++	24 hr	2 days	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. <b>IRAC-3A</b>
Twospotted spider mites	Check with local Cooperative Extension specialists to determine twospotted spider mite treatment thresholds in your area.					
	Predatory mites ( <i>Phytoseiulus persimilis</i> , <i>Neoseiulus fallacis</i> and others)	Release rates vary based upon predatory species and prey density	**** +++	NA	NA	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.
	abamectin (Agri-Mek 0.15 EC)	16 fl oz	+++	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 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. <b>IRAC-6</b>
	acequinocyl (Kanemite 15 SC)	31 fl oz	++++	12 hr	1 day	Allow 21 days between treatments. Do not make more than 2 applications per season. <b>IRAC-20B</b>
	bifenazate (Acramite 50WP)	1 lb	++++	12 hr	1 day	Use only 2 applications per year. Use in a minimum of 100 gal/acre. <b>IRAC-UN</b>
	etoxazole (Zeal 72 WSP)	3 oz	+++	12 hr	1 day	Make only 1 application per crop. DO NOT apply more than 3 oz per acre per crop. <b>IRAC-10B</b>
	fenpyroximate (Portal)	2 pt	+++	12 hr	1 day	<b>IRAC-21A</b>
	hexakis (Vendex 50 WP)	1.5 to 2 lb	++	48 hr	1 day	Do not make more than 2 applications per season. <b>IRAC-12B</b>

## Post-planting: Insect Management

Pest/Problem	Management Options	Amount of Formulation per Acre	Effectiveness (+) or Importance (*)	REI	PHI	Comments (FRAC/IRAC Code)
Twospotted spider mites (continued)	hexythiazox (Savey 50 WP)	6 oz	+++	12 hr	3 days	Controls eggs and immature mites but not adults. Use only once. <b>DO NOT</b> apply more than 6 oz per crop. <b>DO NOT</b> use in strawberry nurseries. If many adult mites are present, use a material effective on adult mites, such as Agri-Mek. <b>IRAC-10A</b>
	insecticidal soap (M-Pede)	1 to 2 gal per 100 gal	+	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 & peppermint oils (Ecotec) (Ecotrol)	32 to 64% by volume	+	0 hr	0 days	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. Ecotec and Ecotrol are <b>OMRI</b> listed.
	sucrose octanoate (SucraShield)	0.8 to 1.0 % v/v	+	48 hr	0 days	Data for SucraShield against twospotted spider mites are limited. Apply in a volume of 100 to 200 gal per acre. <b>OMRI</b> listed.
	spiromesifen (Oberon 2 SC)	12 to 16 fl oz	++++	12 hr	3 days	Make no more than 3 applications per crop. Use in a minimum of 100 gal/acre. <b>IRAC-23</b>
	Horticultural oils (many products) (JMS Stylet Oil, Organic JMS Stylet Oil) (Omni Supreme Spray) (Saf T Side)	See label 0.75% by volume  1 - 2% by volume  1.25 to 2.5 fl oz	++	0 hr	4 hr	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. Organic JMS Stylet Oil and Saf T Side are <b>OMRI</b> listed.

## New Leaf Growth to Pre-bloom: Disease Management

Pest/Problem	Management Options	Amount of Formulation per Acre	Effectiveness (+) or Importance (*)	REI	PHI	Comments (FRAC/IRAC Code)
<p><b>Botrytis crown rot</b> may occur during warm winter periods after early bloom is frost killed and colonized by <i>Botrytis</i>. 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.</p>						
Botrytis crown rot	Rovral 4F and generics (iprodione)	1.5 to 2 pt	++++	24 hr	NA	Do not apply after first fruiting flower, and do not make more than 1 application of Rovral per season. 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. <b>FRAC-2</b>
	Switch 62.5 WG	11 to 14 oz	++++	12 hr	0 days	See resistance management information on page 8. <b>FRAC-12, FRAC-9</b>
	Captan 50W Captan 80WDG	3 to 6 lb (50W) 1.9 - 3.8 lb (80WDG)	++	24 hr	1 day	See notes below. <b>FRAC-M4</b>
Botrytis	Remove dead and dying leaves just before bloom		**  +++			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. Do not use QoI products- these should be saved for use as fruit develop and to avoid selection of resistant populations.
<p><b>Leaf spots, Leaf blights and Powdery Mildew</b> 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. Phomopsis and leaf spot may be associated with plant sources; therefore, disease incidence can vary from year to year. Warm wet weather favors disease progress. See previous notes on powdery mildew under “Planting and Early Post-planting: Disease Management” (page 8). In the spring, monitor fields closely observing the underside of strawberry leaves to determine if powdery mildew is present. Group 11 products or mixtures with Group 11 fungicides are labeled but not listed to manage powdery mildew and leaf spots in order to optimize Group 11 use for anthracnose fruit rot control.</p>						
Phomopsis leaf blight	Captan 50W	3 to 6 lb (50W)	++	24 hr	1 day	When foliar symptoms appear, make 1 or 2 captan applications plus Topsin-M at a 10- to 14-day interval for better control than captan products alone would provide. Do not apply more than 24 lb captan active ingredient per acre per year. <b>FRAC-M4</b>
	Captan 80WDG	1.9 - 3.8 lb (80WDG)	++	24 hr	1 day	
	Captan 4L	2.5 qt	++	24 hr	1 day	
	Topsin-M 70WP	1 lb	++	12 hr	1 day	See note above on page 8 resistance management. <b>FRAC-1</b>
	Rally 40WSP	2.5 to 5 oz	++++	24 hr	0 days	Rally is registered for control of leaf spot, leaf blight, and powdery mildew. Do not apply more than 30 oz per acre. <b>FRAC-3</b>



## New Leaf Growth to Pre-bloom: Disease Management

Pest/Problem	Management Options	Amount of Formulation per Acre	Effectiveness (+) or Importance (*)	REI	PHI	Comments (FRAC/IRAC Code)
Common leaf spot Leaf scorch Leaf blight (e.g. Mycosphaerella, Phomopsis, Gnomonia)	Captan 50W or Captan 80 WDG plus Topsin-M 70WP	1 lb (50W); 1.6 lb (80WDG)  1 lb	+++	24 hr  12 hr	1 day  1 day	When foliar symptoms appear, make 1 or 2 captan applications plus Topsin-M at a 10- to 14-day interval for better control than captan products alone would provide. Do not apply more than 24 lb captan active ingredient per acre per year. Do not tank mix captan products with highly alkaline pesticides, such as Bordeaux mixture. See resistance management notes on page 8. <b>FRAC-M4, FRAC-1</b>
	Captan 50W (alone)	1.5 lb (50W)	++	24 hr	1 day	<b>FRAC-M4</b>
	Captan 80 WDG (alone)	2.4 lb (80WDG)				
	Thiram 24/7 Thiram Granuflo	2.6 qt (24/7) 4.4. lb	++	24 hr 24 hr	1 day 3 days	<b>FRAC-M3</b>
	Rally 40WSP	2.5 to 5 oz	++++	24 hr	0 days	Rally is registered for control of leaf spot, leaf blight, and powdery mildew. Do not apply more than 30 oz per year. <b>FRAC-3</b>
Powdery mildew only	Procure 480SC	4 to 8 fl oz	+++++	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 application. <b>FRAC-3</b>
	Rally 40WSP	2.5 to 5 oz	+++++	24 hr	0 days	Rally is registered for control of leaf spot, leaf blight, and powdery mildew. Do not apply more than 30 oz per year. <b>FRAC-3</b>
	Quintec	4 to 6 fl oz	+++++	24 hr	1 day	Do not use more than 4 times per crop and no more than 2 times in a row. Rotate with other mildewcides. Rotation to non-registered crops less than 30 days after application is prohibited. <b>FRAC-3</b>
	Torino	3.4 oz	?	4 hr	0 days	Do not make more than two (2) applications per year. Do not apply more than once every 14 days. <b>FRAC-U6</b>
	Tilt and other generics	4 fl oz	+++	12 hr	0 days	No more than 2 sequential applications should be made before alternating with fungicides that have a different mode of action. <b>FRAC-3</b>

## New Leaf Growth to Pre-bloom: Disease Management

Pest/Problem	Management Options	Amount of Formulation per Acre	Effectiveness (+) or Importance (*)	REI	PHI	Comments (FRAC/IRAC Code)
Angular (bacterial) leaf spot ( <i>Xanthomonas fragariae</i> )	Basic copper sulfate (various formulations)	2 to 3 lb/100 gal	+	48 hr	0 hr	<p>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.</p> <p>NOTE: All copper sulfate, copper hydroxide and other copper products labeled for strawberry can be used, but check label for the proper rate because different products will contain different percents of active ingredient. <b>FRAC-M1. FRAC-M1.</b></p>
	copper hydroxide (various formulations)	0.35 to 0.58 a.i. (various formulations)	+	24 hr	0 days	
	copper salts of fatty and rosin acids (various formulations)	3 – 4 pts (various formulations)	+	12 hr	0 days	
	cuprous oxide (various formulations)	1.05 – 4.2 lbs a.i. (various formulations)		12 hr	0 days	
	Actigard 50WG	0.5 to 0.75 oz./a	+		0 days	
					Labeled for suppression; Do not apply to stressed plants. <b>DO NOT EXCEED MAXIMUM RATE.</b> Actigard is a plant activator and has no direct activity on the bacteria. See supplemental label for details. <b>FRAC-21</b>	

## New Leaf Growth to Pre-bloom: Disease Management

Pest/Problem	Management Options	Amount of Formulation per Acre	Effectiveness (+) or Importance (*)	REI	PHI	Comments (FRAC/IRAC Code)
Red stele; Phytophthora crown/root rots	mefenoxam (Ridomil Gold SL and other formulations)	1 pt	++++	12 hr	0 days	Strawberry plants initiate considerable root growth in the 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. Use proportionately less fungicide for band treatments (e.g., for drip applications). <b>FRAC-4</b>
	Ultra Flourish metalaxyl (MetaStar and generics)	2 pt 2 qt/treated A	++++	48 hr	0 days	
	phosphites (e.g., Aliette, ProPhyt, Phostrol)	Various rates; see label	++	12 hr	0 days	The 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 but sufficient foliage for chemical uptake. <b>FRAC-33</b>

## Pre-bloom: Insect Management

Pest/Problem	Management Options`	Amount of Formulation per Acre	Effectiveness (+) or Importance (*)	REI	PHI	Comments (FRAC/IRAC Code)
<b>Use extreme caution with bloom period treatments. Insecticides and fungicides can negatively impact bees. 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.</b>						
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 leaves and/or excessive sooty mold is present.					
	bifenthrin (Brigade 10 WSB)	6.4 to 32 oz	+++	12 hr	0 days	The use of broad-spectrum insecticides during bloom will damage honeybee populations. DO NOT apply when bees are foraging. Refer to label. <b>IRAC-3A</b>
	flupyradifurone (Sivanto 200 SL)	7.0 to 10.5 fl oz	+++	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.
	imidacloprid (Admire Pro)	10.5 to 14 fl oz (soil) 1.3 fl oz (foliar)	+++	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. <b>IRAC-4A</b>
	thiamethoxam (Platinum)  (Actara)	5 to 12 fl oz (soil)  1.5 to 3 oz (foliar)	++	12 hr	50 days 3 days	Long PHI makes Platinum useful only as a post-transplant material. Do not apply more than 12 oz/acre Actara and 4.01 oz/acre Platinum per year; allow 10 days between applications. DO NOT apply when bees are foraging; after a Platinum or Actara application, WAIT FIVE DAYS before placing beehives into treated fields. <b>IRAC-4A</b>
	malathion (several products) 57 EC	1.5 pt	+	12 hr	3 days	DO NOT apply when bees are foraging. <b>IRAC-1B</b>
	insecticidal soap (M-Pede)	1 to 2 gal per 100 gal	+	12 hr	0 days	Thorough coverage is needed. Plant damage has been noted under some weather conditions.
	Cutworms	See <b>Post-planting: Insect Management</b> recommendations				
Flower thrips	Thrips populations rarely or sporadically require treatment in strawberries. Because materials effective against thrips are often toxic to pollinators, only treat if damaging populations are present and apply materials in the evening to allow for maximum time between application and bee foraging activity. If using insecticides to manage thrips, rotate between different classes if more than one treatment is made.					
	acetamiprid (Assail 30 SG)	4.0 to 6.9 oz	++	12 hr	1 day	Do not apply when bees are foraging. <b>IRAC - 4A</b>
	spinosad (Entrust 80W)	1.25 to 1.5 oz	++	4 hr	1 day	Rotate to a different class of insecticide after 2 successive applications. DO NOT apply more than 9 oz (Entrust) per acre per crop. Entrust is OMRI listed. Spinosad is highly toxic to

## Pre-bloom: Insect Management

Pest/Problem	Management Options	Amount of Formulation per Acre	Effectiveness (+) or Importance (*)	REI	PHI	Comments (FRAC/IRAC Code)
Flower thrips continued						pollinators when wet. If treatment is necessary, treat in the evening when bees are not foraging to allow for maximum dry time. <b>IRAC-5</b>
	spinetoram (Radiant SC)	6 to 10 fl oz	++	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. <b>IRAC-5</b>
Imported fire ants	Ensure that ants are actively foraging before applying baits.					
	pyriproxyfen (Esteem Ant Bait 0.5% B)	1.5 to 2 lb	+++	12 hr	1 day	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. <b>IRAC-7C</b>
	methoprene (Extinguish Ant Bait 0.5 % B)	1 to 1.5 lb	+++	4 hr	0 days	Esteem and Extinguish are insect growth regulators (IGR) and act on the reproductive activity of the queen(s). Allow 3 weeks to see reduction in mound activity and 8 to 10 weeks for mound elimination. Extinguish can be applied as a mound treatment or broadcast. Extinguish is labeled for use on cropland, but Extinguish Plus is <b>NOT</b> labeled for use on cropland. Read labels carefully. <b>IRAC-7A</b>
Slugs and snails	carbaryl (Sevin) 5 Bait	40 lb	+	12 hr	7 days	Apply bait to edges of beds at dusk. <b>DO NOT</b> contaminate fruit. Repeated applications may be necessary. May also control other soil dwelling insects. <b>IRAC-1A</b>
	Iron phosphate (Sluggo Snail and Slug Bait)	20 to 44 lb	++	0 hr	0 days	Apply in the evening. Some iron phosphate formulations are <b>OMRI</b> listed, check the label.
Strawberry clippers	See <b>Post-planting: Insect Management</b> recommendations					
Twospotted spider mites	See <b>Post-planting: Insect Management</b> recommendations					

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

The primary diseases of concern at early bloom and into harvest are **Botrytis fruit rot** and **anthracnose fruit rot (AFR)**. Most growers rarely experience anthracnose problems and may not need an anthracnose management program. Several **key principles** should be kept in mind:

1. Abound, Azaka, Cabrio, Merivon, Pristine, Luna Sensation belong to the same family of chemicals (QoI; Group 11 chemistry). Pyraclostrobin (Cabrio, Merivon, and Pristine) has offered better control of AFR in recent research efforts. No more than 2 applications of a Group 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 a number of diseases, especially those caused by Botrytis.
2. Captan, Thiram, and Switch offer a broad spectrum of disease control. Switch has not performed well against AFR in NC research.
3. Polyoxin D (PhD; OSO 5%SC; Tavano 5%SC) is as effective as captan for Botrytis at high label rates and can help reduce the number the number of captan sprays. Consider substituting Polyoxin D up to 2 times for captan or thiram. Polyoxin D has low activity against AFR.
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. High risk fungicides of the same chemical class should not be applied in consecutive applications.
6. CaptEstate is a premix of captan and Elevate which has good broad-spectrum activity.
7. 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 anthracnose fruit rot control.
8. 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.
9. Botrytis has acquired resistance to several fungicides. Tests can be secured through Clemson University to help determine farm-specific recommendations. In the absence of such tests, growers should rely primarily on captan for gray mold control. For instructions on sampling contact Dr. Schnabel at [schnabe@clemson.edu](mailto:schnabe@clemson.edu).

For growers who **have** a received a resistance profile report, follow the recommendations in that report.

For growers who **do not have** a report and who adopt a conservative (low risk) fungicide program, apply sprays every 7 to 10 days according to **ONE** of the following suggested schedules.

**For cases when there is no risk of anthracnose and growers need to focus on gray mold control (most fields):** Initiate the first application with Switch and then rotate two or more of the following: polyoxin D; thiram; captan; CaptEstate; captan + Fontelis OR Kenja. But only thiram or captan can be applied more than twice per season due to resistance management.

Options: For a reduced fungicide program, initiate applications at FIRST bloom as above but apply subsequent sprays before predicted wet weather that favors Botrytis; end applications about 26 to 30 days before expected final harvests. Increase the time between spray applications when dry weather persists. Research trials have documented that 4 sprays during bloom are sufficient to offer season-long Botrytis fruit rot control. Also, consult available forecasting models (see above).

**For cases where anthracnose fruit rot risk is high and gray mold control is also needed:**

Application 1: early bloom spray (when covers come off and/or there are 2-4 flowers per plant)  
captan (medium to high rate) + Cabrio EG (12 oz)

Application 2: CaptEstate (if your resistance profile shows you do not have FRAC 17 resistance in the BFR population) **OR** captan alone (if your resistance profile indicates FRAC 17 resistance).

Application 3: same as application 1.

Application 4 and every 7-10 days: Rotate the following: captan; captan + Cabrio EG (12 oz).

In other words, there should be continuous coverage with Captan, a FRAC 11 or FRAC 3 products, or the combination. Follow **key principle 1** above. Before predicted periods of cool and wet weather during bloom, use Switch for better Botrytis control. Use Switch with captan IF Botrytis pressure is expected to be heavy.

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

Pest/Problem	Management Options	Amount of Formulation per Acre	Effectiveness (+) or Importance (*)	REI	PHI	Comments (FRAC/IRAC Code)
Switch also has decent anthracnose control. Pristine, Merivon, or Cabrio show the best efficacy against AFR under high anthracnose pressure in research studies and either can be used if there is no resistance to FRAC 7. Also, if weather conditions (warm & wet) favor AFR, or you start to approach the upper limit of FRAC 11 fungicides allowed (4-5 applications), consider rotating to a tank mix of captan + Tilt.						
Botrytis gray mold	Captan 50W Captan 80WDG	3 to 6 lb (50W) or 1.9-3.8 lb (80W)	+++	24 hr	1 day	See suggested schedule above on page 22. Do not apply more than 24 lb of captan active ingredient per acre per year. <b>FRAC-M4</b>
	Captan 4L	2.5 qt	+++	24 hr	1 day	
	Switch 62.5WG	11 to 14 oz	+++++	12 hr	0 days	Do not apply more than twice per season due to resistance management. See resistance management notes on page 8 and 20. <b>FRAC-12, FRAC-9</b>
	Ph-D WDG	6.2 oz	+++	4 hr	0 days	Do not apply more than twice per season due to resistance management. <b>FRAC-19</b>
	OSO 5%SC Tavano 5%SC	6.5 – 13 fl oz	+++	4 hr	0 days	Do not apply more than twice per season due to resistance management. <b>FRAC-19</b>
	Thiram 75 WDG Thiram 24/7	4.4 lb (WDG) 2.6 qt (24/7)	+++	24 hr	3 days	Make 3 to 5 applications at 10-day intervals. Thiram is a broad spectrum fungicide similar to captan. <b>FRAC-M3</b>
	Elevate 50WDG	1.5 lb	+++++	4 hr	0 days	Do not apply more than twice per season due to resistance management. Under light pressure, 1.0 lb plus captan may be used (see label). <b>FRAC-17</b>
	Fontelis	16 to 24 fl oz	+++++	12 hr	0 days	Do not apply FRAC-7 products more than twice per season due to resistance management. Some matted row cultivars may show phytotoxicity (see label). <b>FRAC-7</b>
	CaptEstate 68 WDG	3.5 to 5.25 lb	+++++	24 hr	0 days	CaptEstate is a combination product of captan plus Elevate. Do not make more than 2 consecutive applications before switching to a fungicide with a different mode of action. Do not apply more than 21.0 lb/acre/season. With plastic mulch, do not apply within 16 feet of naturally vegetated or aquatic areas. <b>FRAC-M4, FRAC-17</b>

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

Pest/Problem	Management Options	Amount of Formulation per Acre	Effectiveness (+) or Importance (*)	REI	PHI	Comments (FRAC/IRAC Code)
Botrytis gray mold (continued)	Scala	18 fl oz 9 fl oz	+++	12 hr	1 day	Use lower rate only in a tank mix with another fungicide active against gray mold (e.g. captan or Thiram). <b>FRAC-12</b>
	Luna Tranquility	16-27 fl oz	+++++	12 hr	0 day	Do not use any FRAC 11 or 7 products more than twice per season for resistance management. <b>FRAC-11, FRAC-7</b>
	Luna Sensation	6-7.6 fl oz	+++++	12 hr	0 day	Do not use any FRAC 11 or 7 products more than twice per season for resistance management. <b>FRAC-11, FRAC-7</b>
	Fracture	24.4 – 36.6 fl oz	+	4 hr	1 day	Active ingredient is a protein extract of sweet white Lupin seeds. Some efficacy can be expected at the highest rate.
Botrytis and Anthracnose (acutatum)	Products in this section are labeled for both botrytis and anthracnose.					
	Pristine WG	18.5 to 23 oz	+++++	12 hr	0 days	Do not apply more than 2 applications per acre per crop year. See page 22. <b>FRAC-11, FRAC-7</b>
	Luna Sensation	6-7.6 fl oz	+++++	12 hr	0 day	Do not use any FRAC 11 or 7 products more than twice per season for resistance management. <b>FRAC-11, FRAC-7</b>
	Merivon	8 to 11 fl oz	+++++	12 hr	0 days	Do not apply more than 2 applications per acre per crop year. See page 22. <b>FRAC-11, FRAC-7</b>
	Captan 50W Captan 80 WDG	3 to 6 lb (50W) 1.9-3.8 lb (80WDG)	+++	24 hr	1 day	For better control and resistance management, use captan applications plus Topsin-M (see label). See suggested schedule above. Do not apply more than 24 lb of captan active ingredient per acre per year. <b>FRAC-M4</b>
Anthracnose (acutatum)	Abound 2.08 F Azaka	6.2 to 15.4 fl oz	+++ (failure found in some fields)	4 hr	4 hr	See notes on page 22 to manage risk of developing fungicide resistance. In recent research, Abound and similar products has performed less well than Cabrio/Pristine. <b>FRAC-11</b>
	Luna Sensation	4-7.6 fl oz	+++++	12 hr	0 day	Do not use any FRAC 11 or 7 products more than twice per season for resistance management. <b>FRAC-11, FRAC-7</b>
	Merivon	5.5 to 8 fl oz	++++	12 hr	0 days	See notes on page 22 to manage risk of developing fungicide resistance. <b>FRAC-11, FRAC-7</b>
	Pristine WG	18.5 to 23 oz	++++	12 hr	0 days	See notes on page 22 to manage risk of developing fungicide resistance. <b>FRAC-11, FRAC-7</b>



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

Pest/Problem	Management Options	Amount of Formulation per Acre	Effectiveness (+) or Importance (*)	REI	PHI	Comments (FRAC/IRAC Code)
	Cabrio EG	12 to 14 oz	++++	12 hr	0 days	See notes on page 22 to manage risk of developing fungicide resistance. <b>FRAC-11</b>
Anthracnose (acutatum) (continued)	Tilt and multiple generics	4 fl oz	++?	12 hr	0 days	Registered for Anthracnose Fruit Rot only. 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. <b>FRAC-3</b>
	Quadris Top	12 to 14 fl oz	+++	12 hr	0 days	Premix of two active ingredients, azoxystrobin ( <b>FRAC-11</b> ) and difenoconazole ( <b>FRAC-3</b> ). No more than 2 applications should be made per season for resistance management.
	Protocol	1.33 pt	+++	24 hr	1 day	Premix of two active ingredients, thiophanate-methyl ( <b>FRAC-1</b> ) and propiconazole ( <b>FRAC-3</b> ). No more than 2 applications should be made per season for resistance management.
Anthracnose ('gloeosporioides' crown rot)	Captan 50W	3 to 6 lb (50W)	++	24 hr	1 day	In plantings known to be infected with the anthracnose crown rot pathogen, consider applying captan plus Topsin-M at 10- to 14-day intervals, for a total of 2 to 3 applications in the fall. <b>FRAC-M4</b>
	Captan 80WDG	1.9-3.8 lb (80W)				
	Captec 4L	2.5 qt	++	24 hr	1 day	<b>FRAC-M4</b>
	Topsin-M 70WP	1 lb	++	12 hr	1 day	See note (page 22) on resistance management. <b>FRAC-1</b>
	Quadris Top	12 to 14 fl oz	+++	12 hr	0 days	Same as above. <b>FRAC-3, FRAC-11</b>
Powdery mildew (only)	Procure 50WS	4 to 8 oz	+++++	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 application. <b>FRAC-3</b>
	Procure 480SC	4 to 8 fl oz				
	Rally 40WSP	2.5 to 5 oz	+++++	24 hr	0 days	Rally is registered for control of leaf spot, leaf blight, and powdery mildew. Do not apply more than 30 oz per year. <b>FRAC-3</b>
	Quintec	4 to 6 fl oz	+++++	24 hr	1 day	Do not use more than 4 times per crop and no more than 2 times in a row. Rotate with other mildewcides. Rotation to all other crops within 1 year after application, unless Quintec is registered for use on those crops, is prohibited. <b>FRAC-13</b>

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

Pest/Problem	Management Options	Amount of Formulation per Acre	Effectiveness (+) or Importance (*)	REI	PHI	Comments (FRAC/IRAC Code)
	Torino	3.4 oz	?	4 hr	0 days	Do not make more than two (2) applications per year. Do not apply more than once every 14 days. <b>FRAC-U6</b>
Powdery mildew and Anthracnose (acutatum)	Abound 2.08 F Azaka	6.2 to 15.4 fl oz	++++	4 hr	4 hr	See notes on page 22 to manage risk of developing fungicide resistance. <b>FRAC-11</b>
	Pristine WG	18.5 to 23 oz	++++	12 hr	0 days	See notes on page 22 to manage risk of developing fungicide resistance. <b>FRAC-11, FRAC-7</b>
	Luna Sensation	4-7.6 fl oz	+++++	12 hr	0 day	Do not use any FRAC 11 or 7 products more than twice per season for resistance management. <b>FRAC-11, FRAC-7</b>
	Cabrio EG	12 to 14 oz	++++	12 hr	0 days	See notes on page 22 to manage risk of developing fungicide resistance. <b>DO NOT EXCEED 1.5 QT/YEAR. FRAC-11</b>
	Tilt and multiple generics	4 fl oz	+++	12 hr	0 days	Registered for Anthracnose Fruit Rot only. 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. <b>FRAC-3</b>
	Quadris Top	12 to 14 fl oz	+++	12 hr	0 days	Premix of two active ingredients, azoxystrobin ( <b>FRAC-11</b> ) and difenoconazole ( <b>FRAC-3</b> ). No more than 2 applications should be made per season for resistance management.

Harvest: Insect Management						
Pest/Problem	Management Options	Amount of Formulation per Acre	Effectiveness (+) or Importance (*)	REI	PHI	Comments (FRAC/IRAC Code)
Aphids	See <b>Pre harvest – Bloom</b> insect management recommendations					
Leaf rolling caterpillars	Leaf rolling caterpillars are rarely pests in southeastern strawberries and should only be treated if feeding or webbing is on or near fruit.					
	<i>Bacillus thuringiensis</i> (Bt) (numerous products)	Rates vary	++			Many Bt formulations are <b>OMRI</b> listed. <b>IRAC–11B2.</b>
	chlorantraniliprole (Coragen)	3.5 to 7.5 fl oz	++++	4 hr	1 day	<b>IRAC-28</b>
	methoxyfenozide (Intrepid)	6 to 12 fl oz	+++	4 hr	3 days	<b>IRAC–18</b>
	spinosad (Entrust) (Success)	1 to 1.25 oz 4 to 6 fl oz	++++	4 hr	1 day	Rotate to a different class of insect control products after 2 successive applications of spinosad. Do not make more than 5 applications per year. Do not apply more than 9 oz of Entrust (0.45 AI of spinosad) per acre per crop. Entrust is <b>OMRI</b> listed. <b>IRAC–5</b>
Sap beetles	Cultural control		++++			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 <b>disposed of either off site or buried</b> . 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)	12 fl oz	++++	12 hr	1 day	Allow 7 days between applications. <b>DO NOT</b> apply more than 36 fl oz/acre per season. The use of adjuvants or surfactants is prohibited. <b>IRAC–15</b>
Slugs and snails	See Pre harvest – Bloom insect management recommendations					

## Harvest: Insect Management

Pest/Problem	Management Options	Amount of Formulation per Acre	Effectiveness (+) or Importance (*)	REI	PHI	Comments (FRAC/IRAC Code)
Tarnished plant bugs	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.					
	bifenthrin (Brigade 10 WSB)	6.4 to 32 oz	++	12 hr	0 days	The use of broad-spectrum insecticides during bloom will damage honeybee populations. DO NOT apply when bees are foraging. Refer to label. <b>IRAC-3A</b>
	fenpropathrin (Danitol 2.4 EC)	10.67 fl oz	++	24 hr	2 days	DO NOT make more than 2 applications. DO NOT apply when bees are foraging. <b>IRAC-3A</b>
	novaluron (Rimon 0.83 EC)	9 to 12 fl oz	++++	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. <b>IRAC-15</b>
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. <b>Materials effective against SWD are toxic to bees.</b> Apply SWD treatments in the evening or night, when bees are not actively foraging.					
	bifenthrin (Brigade 10 WSB)	6.4 to 32 oz	++++	12 hr	0 days	The use of broad-spectrum insecticides during bloom will damage honeybee populations. DO NOT apply when bees are foraging. Refer to label. <b>IRAC-3A</b>
	fenpropathrin (Danitol 2.4 EC)	10.67 fl oz	+++	24 hr	2 days	DO NOT make more than 2 applications. DO NOT apply when bees are foraging. <b>IRAC-3A</b>
	malathion (several products) 57 EC	1.5 to 3 pt	++	12 hr	3 days	DO NOT apply when bees are foraging. <b>IRAC-1B</b> DO NOT apply more than 3.2 pts 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.
	spinetoram (Radiant SC)	6 to 10 fl oz	++++	4 hr	1 day	<b>IRAC-5</b>

<b>Harvest: Insect Management</b>						
<b>Pest/Problem</b>	<b>Management Options</b>	<b>Amount of Formulation per Acre</b>	<b>Effectiveness (+) or Importance (*)</b>	<b>REI</b>	<b>PHI</b>	<b>Comments (FRAC/IRAC Code)</b>
Spotted wing drosophila (continued)	spinosad (Entrust 80 W)		++	4 hr	1 day	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. Do not make more than 5 applications per year. Do not apply more than 9 oz of Entrust (0.45 AI of spinosad) per acre per crop. Entrust is <b>OMRI</b> listed. <b>IRAC-5</b>
Twospotted spider mites	Same as <b>Post-planting: Insect Management</b> recommendations.					
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	+++	12 hr	7 days	DO NOT apply when bees are foraging. <b>IRAC-4A</b>
	novaluron (Rimon 0.83 EC)	9 to 12 fl oz	+++	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. <b>IRAC-15</b>
	spiromesifen (Oberon 2 SC)	12 to 16 fl oz	+++	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. <b>IRAC-23</b>
	thiamethoxam (Actara)	3 to 4 oz	++	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. <b>IRAC-4A</b>

**Relative Effectiveness of Various Chemicals for Strawberry Disease Control**  
 (— = ineffective; +++ = very effective; ? = efficacy unknown)

Pesticide	Relative Control Rating											
	Anthracnose (crown rot)	Anthracnose (fruit rot)	Gray mold	Powdery mildew	Common leaf spot	Leaf blight and fruit rot	Leather rot	Mucor fruit rot	Rhizopus rot	Angular leaf spot	Phytophthora crown rot	Red stele root rot
<i>Strobilurins:</i>												
azoxystrobin (Abound; Azaka)	++	+	+	+	+	—	+++	—	—	—	—	—
pyraclostrobin (Cabrio)	++	+++	+	+	+	—	+++	—	—	—	—	—
pyraclostrobin + boscalid (Pristine)												
pyraclostrobin + fluxapyroxad (Merivon)	++	+++	+++ <sup>R</sup>	+	+++	+++	—	?	?	—	—	—
trifloxystrobin + fluopyram (Luna Sensation)												
acibenzolar-S-methyl (Actigard)	—	—	—	—	—	—	—	—	—	+	—	—
azoxystrobin + difenoconazole (Quadris Top)	++	++	+	++	++	?	+	—	—	—	—	—
azoxystrobin + propiconazole (QuiltXcel)	+++	++	—	++	?	?	—	—	—	—	—	—
fluopyram + pyrimethanil (Luna Tranquility)	—	—	+++ <sup>R</sup>	++	—	—	—	—	—	—	—	—
BLAD (Fracture)	?	?	+	+	?	?	—	?	?	—	—	—
captan (Captan and generics)	++	++	++	—	++	+	+	+	+	—	—	—
Cyflufenamid (Torino)	-	-	-	+++	-	-	-	-	-	-	-	-
copper	—	—	—	—	+ <sup>P</sup>	—	+ <sup>P</sup>	—	—	+ <sup>P</sup>	—	—
cyprodinil + fludioxinil (Switch)	++	+	+++ <sup>R</sup>	?	+?	+?	—	?	?	?	—	—
fenhexamide (Elevate)	—	—	+++ <sup>R</sup>	—	—	—	—	—	—	—	—	—
fenhexamide + captan (CaptEvate)	+	++	+++	—	++	+	+	+	+	—	—	—
fosetyl-Al (Aliette)	—	—	—	—	—	—	++	—	—	—	++	++
iprodione (Rovral and generics)	—	—	+++ <sup>R</sup>	—	++	—	—	X	—	—	—	—

**Relative Effectiveness of Various Chemicals for Strawberry Disease Control**  
 (— = ineffective; +++ = very effective; ? = efficacy unknown)

Pesticide	Relative Control Rating											
	Anthracnose (crown rot)	Anthracnose (fruit rot)	Gray mold	Powdery mildew	Common leaf spot	Leaf blight and fruit rot	Leather rot	Mucor fruit rot	Rhizopus rot	Angular leaf spot	Phytophthora crown rot	Red stele root rot
mefenoxam (Ridomil) or similar products	—	—	—	—	—	—	+++ <sup>R</sup>	—	—	—	+++	+++
metalaxyl (MetaStar) or similar products	—	—	—	—	—	—	+++ <sup>R</sup>	—	—	—	+++	+++
myclobutanil (Rally)	—	—	—	+++ <sup>R</sup>	++ <sup>R</sup>	++ <sup>R</sup>	—	—	—	—	—	—
penthiopyrad (Fontelis)	—	—	+++ <sup>R</sup>	++ <sup>R</sup>	—	—	—	—	—	—	—	—
phosphites (ProPhyt; Phostrol and others)	—	—	—	—	—	—	++	—	—	—	++	++
Polyoxin D (Ph-D; OSO; Tavano)	?	?	++	—	?	?	?	?	?	?	?	?
propiconazole (Tilt; other generics)	+	++	-	++ <sup>R</sup>	++?	?	-	-	-	-	-	-
pyrimethanil (Scala)	—	—	++ <sup>R</sup>	—	—	—	—	—	—	—	—	—
quinoxifen (Quintec)	—	—	—	+++	—	—	—	—	—	—	—	—
Sulfur	—	—	—	++ <sup>P</sup>	—	—	—	—	—	—	—	—
thiophanate-methyl (Topsin M)	++ <sup>R</sup>	—	++ <sup>R</sup>	+ <sup>R</sup>	++	++	—	X	—	—	—	—
thiophanate-methyl + propiconazole (Protocol)	++ <sup>R</sup>	++	++ <sup>R</sup>	++ <sup>R</sup>	++	++	—	X	—	—	—	—
thiram (Thiram)	++	++	++	—	+	+	+	+	+	—	—	—
triflumizole (Procure)	—	—	?	+++ <sup>R</sup>	?	?	—	—	—	—	—	—

<sup>R</sup> = Not effective if pathogen is resistant to the fungicide.

<sup>P</sup> = Phytotoxicity could occur.

**X** = Chemical use increases problem

### Plasticulture Weed Control: Preplant

Weed	Fumigant or Herbicide and WSSA Mechanism of Action (MOA) Code	Amount of Formulation per Acre	Crop Age Restrictions	REI	Comments
Annual grasses, broadleaf weeds, and yellow and purple nutsedge	Fumigation—see tables above (page 10).				Annual grass and broadleaf weeds
Yellow and purple nutsedge, broadleaf, and grass	EPTC MOA 8 (Eptam) 7E	3.5 to 7 pt	Apply to soil surface at least 45 days before planting.	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.
Annual broadleaf weeds, including Carolina geranium and cutleaf evening primrose	oxyfluorfen MOA 14 (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.
Annual broadleaf weeds	acifluorfen MOA 14 (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	<b>Crop row.</b> 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.



## Plasticulture Weed Control: Preplant

Weed	Herbicide and WSSA Mechanism of Action (MOA) Code	Amount of Formulation per Acre	Crop Age Restrictions	REI	Comments
Annual broadleaf weeds including cutleaf evening primrose, henbit, chickweed, horseweed, wild radish and suppression of some annual grasses	flumioxazin MOA 14 (Chateau SW) 51 WDG	3 oz	Apply to soil surface of pre-formed beds at least 30 days before transplanting.	12 hr	<b>Crop row.</b> Apply a minimum of 30 days prior to transplanting and prior to plastic mulch being laid.
Broadleaf weeds	napropamide MOA 15 (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 treatment preplant 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 hours (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 hours.
Yellow nutsedge, purple nutsedge, corn spurry, yellow woodsorrel, henbit, chickweed	sulfentrazone MOA 14 (Spartan) 4F	4 to 8 oz; see label for soil restrictions			Apply prior to planting and before weeds have emerged. Please refer to label for soil type restrictions.

<b>Plasticulture Weed Control: Postemergence</b>					
<b>Weed</b>	<b>Herbicide and WSSA Mechanism of Action (MOA) Code</b>	<b>Amount of Formulation per Acre</b>	<b>Crop Age Restrictions</b>	<b>REI</b>	<b>Comments</b>
Broadleaf weeds including ragweed, clover, vetch, curly dock, dandelion, sowthistle, thistle, red sorrel, and nightshade	clopyralid MOA 4 (Stinger) 3 EC	<b>Crop row:</b> 0.33 to 0.5 pt  <b>Row middle:</b> 0.33 to 0.67 pt	Apply after strawberry plants are established and at least 30 days before harvest.	12 hr	<b>The Stinger registration in strawberry is issued on a state-by-state basis; therefore, it may NOT be registered for use in all states using this guide.</b> 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.
Annual and perennial grasses	clethodim MOA 1 (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/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 gal spray mix.
Annual and perennial grasses	sethoxydim MOA 1 (Poast) 1.5EC	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/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 per acre per year.
<b>Plasticulture Weed Control: Row middles</b>					
<b>Weed</b>	<b>Herbicide and WSSA Mechanism of Action (MOA) Code</b>	<b>Amount of Formulation per Acre</b>	<b>Crop Age Restrictions</b>	<b>REI</b>	<b>Comments</b>
Annual broadleaf weeds	acifluorfen MOA 14 (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.

<b>Plasticulture Weed Control: Row middles</b>					
<b>Weed</b>	<b>Herbicide and WSSA Mechanism of Action (MOA) Code</b>	<b>Amount of Formulation per Acre</b>	<b>Crop Age Restrictions</b>	<b>REI</b>	<b>Comments</b>
Annual broadleaf weeds including cutleaf evening primrose, henbit, chickweed, horseweed, wild radish and suppression of some annual grasses	flumioxazin MOA 14 (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.
Nonselective weed control	glyphosate MOA 9 (Various formulations)	See label	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.
	paraquat MOA 22 (Firestorm, 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/50 gal. of spray 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.
	pelargonic acid MOA 27 (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.
Annual broadleaf weeds Most effective on weeds less than 4 in. tall or rosettes less than 3 in. in diameter	carfentrazone MOA 14 (Aim) 2 EC and 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 gallon per 100 gallons solution or a nonionic surfactant at 2 pint per 100 gallons of spray solution. Coverage is essential for good weed control. Does not control grass weeds.

### Matted Row Weed Control: Preplant

Weed	Fumigant and WSSA Mechanism of Action (MOA) Code	Amount of Formulation per Acre	Crop Age Restrictions	REI	Comments
Annual grasses, broadleaf weeds, and yellow and purple nutsedge	Fumigation—see tables above (page 10).		See labels for plant-back intervals.	See labels for details.	See labels for rates, plant-back intervals, and personal protective equipment requirements.

### Matted Row Weed Control: Preemergence

Weed	Herbicide and WSSA Mechanism of Action (MOA) Code	Amount of Formulation per Acre	Crop Age Restrictions	REI	Comments
Annual grasses and small-seeded broadleaf weeds including common chickweed, field pansy	DCPA MOA 3 (Dacthal) 6 L 75-W	8 to 12 pt 8 to 12 lb	Newly planted and established plantings before bloom	12 hr	Apply to the soil prior to planting. Can be preplant incorporated. Apply to established plantings in fall to early spring prior to first bloom.
Annual grasses and small-seeded broadleaf weeds	napropamide MOA 15 (Devrinol and Devrinol 2-XT) 2 EC Devrinol and 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 hours is needed for optimum weed control. See XT labels for information regarding delay in irrigation event.
Annual broadleaf weeds and grasses including chickweed, henbit, annual pepperweed, Shepherd's purse	terbacil MOA 5 (Sinbar) 80 WDG	see label for rate	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 in. 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

### Matted Row Weed Control: Preemergence

Weed	Herbicide and WSSA Mechanism of Action (MOA) Code	Amount of Formulation per Acre	Crop Age Restrictions	REI	Comments
					apply within 110 days of harvest. See label for more information.
Annual broadleaf weeds including yellow rocket, shepherd's purse, Virginia pepperweed, common chickweed, common groundsel	acifluorfen MOA 14 (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.
Annual broadleaf weeds	flumioxazin MOA 14 (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.
Yellow nutsedge, purple nutsedge, corn spurry, yellow woodsorrel, henbit, chickweed and other broadleaf weeds	sulfentrazone MOA 14 (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.

### Matted Row Weed Control: Postemergence

Weed	Herbicide and WSSA Mechanism of Action (MOA) Code	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 MOA 4 (Stinger) 3 EC	0.33 to 0.67 pt	Newly planted and established plantings	12 hr	<b>The Stinger registration in strawberry is issued on a state-by-state basis. Therefore, it may NOT be registered for use in all states using this guide.</b> 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.

## Matted Row Weed Control: Postemergence

Weed	Herbicide and WSSA Mechanism of Action (MOA) Code	Amount of Formulation per Acre	Crop Age Restrictions	REI	Comments
Broadleaf weeds	2, 4-D amine MOA 4	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.
	(2, 4-D Amine) 4 SL				
Annual broadleaf weeds	pelargonic acid MOA 27 (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.
Contact kill of all green foliage	paraquat MOA 22 (Firestorm, Parazone) 3 SL (Gramoxone SL) 2 L	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 spray 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.
Annual and perennial grasses	clethodim MOA 1 (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.
	fluazifop MOA 1 (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.
	sethoxydim MOA 1 (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.