

2011 Southeast Regional Strawberry Integrated 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.

Strawberry Integrated Management Guide—Insect and Disease Control

Seasonal “At-a-Glance” Arthropod Guide

Developmental Stage ¹	Post-planting (Fall/early to mid-winter)	Pre-harvest—Bloom (Late winter to early spring) ³	Harvest
Pests Controlled (Insecticides/ Miticides)	Crickets (carbaryl, malathion, Danitol) Cutworms (carbaryl, Danitol, SpinTor, Entrust, malathion, <i>Bt</i> , Intrepid, Radiant) Cyclamen mites (dicofol, imidacloprid) Aphids (Diazinon, Dibrom, Assail, imidacloprid, thiamethoxam, insecticidal soap) Strawberry clippers (Brigade, Danitol, carbaryl, Lorsban) Twospotted spider mites: ² 1. (Agri-Mek, Vendex); 2. (Acramite, Kanemite, Oberon, Savey, Zeal, Portal); 3. (Brigade, Danitol); 4. (M-Pede, horticultural oils); 5. predatory mites	Aphids ³ (Assail, malathion) Fire ants ⁴ —(Extinguish or Esteem Ant Baits, Seduce) Flower thrips ³ (Entrust, Radiant) Slugs/snails (baits containing carbaryl, metaldehyde, and/or iron phosphate) Strawberry clippers (Brigade, Danitol, carbaryl) Twospotted spider mites: ⁶ 1. (Agri-Mek, Vendex); 2. (Acramite, Kanemite, Oberon, Savey, Zeal, Portal); 3. (Brigade, Danitol); 4. (M-Pede, horticultural oils); 5. predatory mites	Fire ants ⁴ — (Extinguish or Esteem Ant Baits, Seduce) Sap beetles ⁷ (cultural control, Brigade, Rimon) Slugs/snails (baits containing carbaryl, metaldehyde, or iron phosphate) Tarnished plant bugs ⁵ (Brigade, Danitol, Rimon) Twospotted spider mites: ⁶ 1. (Agri-Mek, Vendex); 2. (Acramite, Kanemite, Oberon, Savey, Zeal, Portal); 3. (Brigade, Danitol); 4. (M-Pede, horticultural oils) 5. predatory mites Whiteflies (malathion, Danitol, Oberon)

¹ Management of strawberry pests is a reactive program based on the detection of pests in the field. There is no established preventive spray program. Thorough scouting is necessary to detect pests early before infestations build to damaging levels.

² 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 first group are effective against only adult mites. Resistance to these materials may be a problem, particularly if you have had problems with mites previously or the transplants or plugs were infested with mites. The second group of materials is effective against eggs as well as older life stages of the twospotted spider mite; however, these materials would be the primary tools for spring infestations. Fall use could affect the number of applications allowed in the spring. Please follow resistance management guidelines stated on the labels. Group 3 materials should not be used as primary miticides as both Brigade and Danitol are highly toxic to beneficial predators. Post-application scouting when these materials are used is critical. Group 4 materials are organically acceptable (**OMRI** listed) and effective only against adults; coverage is very important to the efficacy of these materials.

³ Aphid or flower thrips populations have to be very high to cause yield loss in strawberry; **treat only if damaging populations are present**. Spraying broad spectrum insecticides during bloom can kill honey bees; follow instructions on pesticide labels to minimize damage to honey bees.

⁴ Fire ant baits work slowly but effectively sterilize the queen and prevent larvae from developing resulting in drastic reduction in the number of ants 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.

⁵ Tarnished plant bugs begin to feed early in the spring on flowers and developing seeds of various weeds. Wild radish, often called “wild mustard,” is a favored late winter host. Keeping weeds down in and around fields will reduce populations. See note above about honey bees

⁶ As weather begins to warm, scout well for mites. Follow label instructions about resistance management carefully when using miticides.

⁷ Sap beetles are attracted to overripe fruit. Keeping this type of fruit picked and removed from the field will reduce problems with sap beetles.

Strawberry Integrated Management Guide (continued)

Pre-planting: Disease Control

Pest/Problem	Management Options	Effectiveness (+) or Importance (*)	Comments
Anthrachnose Angular leaf spot Phytophthora crown rot Viruses		***** +++++	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 may be required
	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.
Weeds Root and crown rot disorders (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.

Relative Efficacy of Currently Registered Fumigants or Fumigant Combinations for Managing Soilborne Nematodes, Diseases, And Weeds¹

Product	Rate per Broadcast Acre	Nematodes	Disease	Nutsedge	Weeds: Annual
Telone C35 ³ (1,3-D + chloropicrin)	35 gal	+++++	+++++	+	+++
Telone C35 + VIF ³	See comments below	+++++	+++++	+++	+++
Metam sodium ² (MS) ³	75 gal	++	+++	+	++++
Chloropicrin ³	150 lb	+	+++++	—	—
Pic-Chlor 60 ³ (chloropicrin + 1,3-D)	150 lb	+++++	+++++	+	+++
Chloropicrin + MS ³	150 lb + 75 gal	++	+++++	?	++++
Midas 50:50 (iodomethane + chloropicrin) ^{3,4}	160 lb	+++++	+++++	+++++	+++++

¹Each of the fumigants listed in this table has performed well in trials and can provide higher returns per acre than methyl bromide. Some alternative fumigants may need to be complemented with herbicides or hand weeding depending on weed pressure. Methyl bromide can only be used in response to specific pest problems listed in the 2011 Critical Use Exemption (CUE), and it is not available to new strawberry growers (only to qualified existing growers). Because of methyl bromide's high cost and diminishing supply, this fumigant is from distributors as a 50:50 formulation with chloropicrin. It is recommended that the rates of MB be reduced by 40 percent for use with virtually impermeable film (VIF); thus, the regular recommended rate of 400 lb methyl bromide per broadcast acre would be reduced to 240 lb per broadcast acre with VIF.

²Metam sodium can be Vapam, Sectagon, or other registered formulations.

³Refer to the "Herbicide Recommendation" section of this guide for directions pertaining to herbicide applications. Reduced rates can be used with VIF. VIF must be used for the Midas 50:50 rate of 160 lb/treated acre. Various formulations of Midas are available.

Strawberry Integrated Management Guide (continued)

Planting and Early Post-planting: Disease and Insect Control

FRAC/IRAC codes—These acronyms refer to industry-sponsored committees addressing resistance to crop protection materials; **Fungicide Resistance and Insecticides Resistance Action Committees**. 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 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.irc-online.org and www.frac.info.

Organic Materials Review Institute (OMRI) listed materials are acceptable for production systems certified as organic. Organically acceptable materials (OMRI listed) are in the Comments section.

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 this 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.

Several products are registered for plant dips to kill 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.

Abound—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 Abound to have some *Rhizoctonia* 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 in early plant growth. Growers must ensure root dip waste is properly disposed of.

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. Dispose of dip solution according to local regulations. 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.

Rovral—Dip the plants in a solution of 2 pints/100 gallons for 1 to 5 minutes and plant immediately. This is primarily for botrytis crown rot and will not improve root health. This treatment is not likely to offer a lot of benefit.

Products like **Oxidate** are registered for plant dip use. However, little data are available, and it is doubtful that they would offer management of root diseases. In most cases, root pathogens are internal to the tissue and these products are primarily surface disinfectants.

Strawberry Integrated Management Guide (continued)

Planting and Early Post-planting: Disease and Insect Control

The * and ** noted in the management option columns below throughout the disease control sections refer to the following fungicide resistance management recommendations:

**Botrytis cinerea* historically has a high potential to develop resistance, therefore it is important to give these recommendations serious consideration:

1. Limit the number of times fungicides of the same class are applied in 1 year.
2. Tank-mix a benzimidazole (Topsin-M) fungicide with a broad spectrum fungicide such as Captan or Thiram.
3. Apply fungicides of the same class in a block of sprays (2 to 3 sprays as specified on the label); then alternate to a fungicide of a different class in the next block of sprays.

**It is currently suggested that the strobilurin (now called QoI or group 11) fungicides (Abound, Cabrio, and Pristine) be saved for use in controlling anthracnose diseases when disease pressure is high. Captan or Thiram should help to 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 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. In 2009 and 2010, we have documented reduced activity with azoxystrobin (Abound) with certain strains of the anthracnose ripe fruit (ARF) rot pathogen. Pyraclostrobin (Cabrio/Pristine) has 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. The 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.

Anthracnose—Most plantings are not 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 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.

Pest/Problem	Management Options	Amount of Formulation per Acre	Effectiveness (+) or Importance (*)	REI	PHI	Comments (FRAC/IRAC Code)
Red stele; <i>Phytophthora</i> and <i>Pythium</i> crown/root rots	mefenoxam (Ridomil Gold EC)	1.0 pt	++++	12 hr	0 days	Apply in sufficient water to move the fungicide into the root zone. Use proportionately less Ridomil Gold EC for band treatments (e.g., for drip applications). Do not exceed 1.5 qt/year. FRAC-4
	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. FRAC-33

Strawberry Integrated Management Guide (continued)

Planting and Early Post-planting: Disease and Insect Control (continued)

<i>Rhizoctonia</i> sp. (seedling root; basal stem rot)	Abound FL**	0.40 to 0.80 fl oz/1,000 row feet	++	4 hr	0 days	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. FRAC-11
Powdery mildew (only)	Procure 50WS	4 to 8 oz	+++++	12 hr	1 day	Do not plant leafy vegetables within 30 days after application. Do not plant root vegetables within 60 days after application. Rotation to all other crops within 1 year after application, unless Procure is registered for use on those crops, is prohibited. FRAC-3
	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. (Rally replaces Nova.) FRAC-3
	sulfur	5 to 10 lb	+++	24 hr	1 day	Spray as needed. See label. FRAC-M2
	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. FRAC-13
Anthracnose ('acutatum')	Pristine WG**	18.5 to 23 oz	+++++	12 hr	0 days	No more than 2 sequential applications of a Group 11 fungicide (Pristine, Abound or Cabrio) should be made before alternating with fungicides that have a different mode of action. Do not apply a Group 11 fungicide more than 1/3 the total number of sprays, if used alone, and no more than 50% of the total applications if mixed with a partner (e.g., Captan). Typically this number is 3 and 4 applications, respectively. FRAC-11, FRAC-7
	Abound FL**	6.2 to 15.4 fl. oz	+++++	4 hr	0 days	Abound FL** FRAC-11
Anthracnose ('gloeosporioides' crown rot)	Captan 50W or Captan 80WDG or	1.5 to 3 lb active ingredient	++	1 day	1 day	In plantings known to be infected with the anthracnose crown rot pathogen, Captan applications plus Topsin-M at a 10- to 14-day interval for 2 to 3 applications in the fall should be considered. FRAC-M4
	Captec 4L or	2.5 qt	++	1 day	1 day	FRAC-M4
	Thiram 75 WDG or	3 lb	+++	1 day	1 day	FRAC-M4
	Topsin-M 70WP* or	1 lb	++	12 hr	1 day	See note (page 2) on resistance management. FRAC-1

Strawberry Integrated Management Guide (continued)

Post-planting: Insect Control

Pest/Problem	Management Options	Amount of Formulation per Acre	Effectiveness (+) or Importance (*)	REI	PHI	Comments (FRAC/IRAC Code)
Crickets	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 may cause spider mite problems. DO NOT apply when bees are foraging. IRAC-1A
	fenpropathrin (Danitol) 2.4 EC	10.67 to 21.33 fl oz	+++	24 hr	2 days	DO NOT make more than 2 applications. Apply in at least 100 gal of water per acre. DO NOT apply when bees are foraging. IRAC-3A
	malathion (several products) 57 EC	1.5 to 3 pt	+	12 hr	3 days	Most insecticides control crickets. Apply when damage is first noted. DO NOT apply when bees are foraging. IRAC-1B
Cutworms	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 may cause spider mite problems. Cutworms are usually more of a problem in matted-row culture. Apply late in the day when plants clipped at the base are first noticed. DO NOT apply when bees are foraging. IRAC-1A
	fenpropathrin (Danitol) 2.4 EC	10.67 to 21.33 fl oz	+++	24 hr	2 days	DO NOT make more than 2 applications. Apply in at least 100 gal of water per acre. DO NOT apply when bees are foraging. IRAC-3A
	spinosad Entrust SpinTor	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 OMRI listed. IRAC-5
	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 where cutworms hide. IRAC-1B
	Methoxyfenozide (Intrepid)	6 to 12 fl oz	+++	4 hr	3 days	IRAC-18
	<i>Bacillus thuringiensis</i> (Bt) (numerous products)	Rates vary	++			Many Bt formulations are OMRI listed. IRAC-11B2 .

Strawberry Integrated Management Guide (continued)

Post-planting: Insect Control (continued)

Pest/Problem	Management Options	Amount of Formulation per Acre	Effectiveness (+) or Importance (*)	REI	PHI	Comments (FRAC/IRAC Code)
Cyclamen mites	imidacloprid (Admire Pro) 4.6 F	10.5 to 14 oz	+++	12 hr	14days	Apply in transplant water or through irrigation. DO NOT apply when bees are foraging or within 10 days of bloom. IRAC-4A
Strawberry clippers	chlorpyrifos (Lorsban Advanced)	2 qt	+++	24 hr	21 days	Prebloom only. Do not make more than 2 applications. Do not apply during high temperatures and drought stress. DO NOT apply when bees are foraging. IRAC-1B
	bifenthrin (Brigade)WSB	6.4 to 32 oz	+++	12 hr	0	DO NOT apply when bees are foraging. IRAC-3
	carbaryl (Sevin XLR)	1 to 2 qt	++	12 hr	1 days	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. IRAC-1A
	fenpropathrin (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. IRAC-3A
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> and others)					Releases rates vary based upon predatory species and prey density. 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 (2 to 5 mites per leaflet), and spider mite populations must be followed closely after predatory mite releases.
	abamectin (Agri-Mek) 0.15 EC	8 to 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. Do not apply in less than 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

Strawberry Integrated Management Guide (continued)

Post-planting: Insect Control (continued)

Pest/Problem	Management Options	Amount of Formulation per Acre	Effectiveness (+) or Importance (*)	REI	PHI	Comments (FRAC/IRAC Code)
Twospotted spider mites (continued)	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. IRAC-20B
	bifenazate (Acramite) 50WP	1 lb	++++	12 hr	1 day	Use only 2 applications per year. Use in a minimum of 100 gal/acre. IRAC-UN
	bifenthrin (Brigade) WSB	16 to 32 oz	++	12 hr	0 days	Do not apply more than 0.5 lb/acre per season. Do not use Brigade as a primary mite control. DO NOT apply when bees are foraging. IRAC-3
	etoxazole (Zeal) 72 WSP	2 to 3 oz	+++	12 hr	1 day	Make only 1 application per crop. DO NOT apply more than 3 oz per acre per crop. IRAC-10B
	fenpropathrin (Danitol) 2.4 EC	16 to 21.33 fl oz	++	24 hr	2 days	Do not make more than 2 applications. Do not retreat within 30 days. Do not use Danitol as a primary mite control. DO NOT apply when bees are foraging. IRAC-3
	fenpyroximate (Portal)	2.0 pt	+++	12 hr	1 day	IRAC-21A
	hexakis (Vendex) 50 WP	1.5 to 2 lb	++	48 hr	1 day	Do not make more than 2 applications per season. IRAC-12B
	hexythiazox (Savey) 50 WP	6 oz	+++	12 hr	3 days	Controls eggs and immature mites but not adults. Use only once. DO NOT apply more than 6 oz per crop. DO NOT use in strawberry nurseries. If many adult mites are present, use a material effective on adult mites, such as Brigade or Danitol. IRAC-10A
	insecticidal soap (M-Pede)	1 to 2 gal per 100 gal	+	12 hr	0 days	Very thorough coverage is needed. Use with caution; plant damage has been noted under some weather conditions. For best results use with low mite populations.
	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. IRAC-23
Horticultural oils (many products) (JMS Stylet Oil, Organic JMS Stylet Oil) (Omni Supreme Spray) (Saf T Side)	See label 0.75% by volume 1 to 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. 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 OMRI listed.	

Strawberry Integrated Management Guide (continued)

New Leaf Growth to Pre-bloom: Disease Control

Botrytis crown rot may occur during warm winter periods after early bloom is frost killed 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.

Pest/Problem	Management Options	Amount of Formulation per Acre	Effectiveness (+) or Importance (*)	REI	PHI	Comments (FRAC/IRAC Code)
Botrytis crown rot	Rovral 50 W (iprodione) or	1.5 to 2 lb	++++	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. FRAC-2
	Switch 62.5 WG* or	11 to 14 oz	++++	12 hr.	0 days	FRAC-12, FRAC-9
	Elevate 50 WDG or	1.5 lb	+++	4 hr	0 days	See notes below. FRAC-17
	CaptEvate 68 WDG or	3.5 to 5.25 lb	+++	24 hr	0 days	See notes below. FRAC-M4, FRAC-17
	Captan 50W or Captan 80WDG	1.5 to 3 lb active ingredient	++	1 day	1 day	See notes below. FRAC-M4

Phomopsis and the various leaf spots and blights 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 2). In the spring, monitor fields closely observing the underside of strawberry leaves to determine if powdery mildew is present.

Phomopsis leaf blight	Captan 50W or Captan 80WDG or	1.5 to 3 lb active ingredient	++	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. FRAC-M4
	Captec 4L or	2.5 qt	++	1 day	1 day	
	Topsin-M 70WP* or	1 lb	++	12 hr	1 day	See note (page 2) on resistance management. FRAC-1

Strawberry Integrated Management Guide (continued)

New Leaf Growth to Pre-bloom: Disease Control (continued)

Pest/Problem	Management Options	Amount of Formulation per Acre	Effectiveness (+) or Importance (*)	REI	PHI	Comments (FRAC/IRAC Code)
Phomopsis leaf blight (continued)	Rally 40WSP	2.5 to 5 oz	++++	24 hr	0	Rally is registered for control of leaf spot, leaf blight, and powdery mildew. Do not apply more than 30 oz per acre. (Rally replaces Nova.) FRAC-3
	Rovral 4FL	1.5 to 2 pt	++	24 hr	See remarks	Do not make more than 1 application per season. Do not apply after the first fruiting flower. FRAC-2
Common leaf spot Leaf scorch Leaf blight	Captan 50W or Captan 80 WDG plus Topsin-M 70WP* or	2 lb active ingredient 1 lb	++++	1 day 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. FRAC-M4, FRAC-1
	Captan 50W or Captan 80 WDG (alone) or	3 lb active ingredient	++	1 day	1 day	
	Syllit 65WP or	1 to 2 lb	+++	2 days	14 days	Syllit 65WP provides control of fungal leaf spot diseases and should be applied early in the season. Syllit 65WP can sometimes cause leaf burn. Captan mixed with Syllit 65WP reduces the potential of leaf burn. If leaf burn occurs, discontinue use of Syllit 65WP. FRAC-M7
	Thiram 65 WP (alone) or	4 to 5 lb	++	1 day	3 days	Make 3 to 5 applications of Thiram 65WP at 10-day intervals or rotate with other fungicides. FRAC-M3
	Rally 40WSP	2.5 to 5 oz	++++	24 hr	0 day	Rally is registered for control of leaf spot, leaf blight, and powdery mildew. Do not apply more than 30 oz per year. FRAC-3
	Rovral 4FL	1.5 to 2 pt	++	24 hr	See remarks	Do not make more than 1 application per season. Do not apply after the first fruiting flower. FRAC-2

Strawberry Integrated Management Guide (continued)

New Leaf Growth to Pre-bloom: Disease Control (continued)

Pest/Problem	Management Options	Amount of Formulation per Acre	Effectiveness (+) or Importance (*)	REI	PHI	Comments (FRAC/IRAC Code)
Powdery mildew (only)	Procure 50WS	4 to 8 oz	+++++	12 hr	1 day	Do not plant leafy vegetables within 30 days after application. Do not plant root vegetables within 60 days after application. Rotation to all other crops within 1 year after application, unless Procure is registered for use on those crops, is prohibited. FRAC-3
	Procure 480SC	4 to 8 fl oz				
	Rally 40WSP	2.5 to 5 oz	+++++	24 hr	0 day	Rally is registered for control of leaf spot, leaf blight, and powdery mildew. Do not apply more than 30 oz per year. FRAC-3
	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. FRAC-13
Angular (bacterial) leaf spot	Basic copper sulfate	2 to 3 lb/100 gal	+	1 day	12 hr	Angular (bacterial) leaf spot can be a serious problem during cool, wet conditions. These compounds provide some control if started when disease first appears. Repeat applications at 7 to 10 day intervals. Discontinue when phytotoxicity appears, usually after 4 to 5 applications. FRAC-M1.
	or					
	KOP 300	2 gal/100 gal	+	12 hr	2 days	
	or					
	Champion 77WP	2 to 3 lb	+	2 days	2 days	
	or					
	Champion 2F	1 to 2 pt	+	2 days	2 days	
or						
Kocide 101	2 to 3 lb	+	1 day	1 day	NOTE: All copper sulfate and copper hydroxide products labeled for strawberry can be used, but check label for the proper rate because different products will contain different percents of active ingredient. FRAC-M1.	
or						
	KOP-Hydroxide	2 to 4 pt/100 gal	+	2 days	2 days	

Strawberry Integrated Management Guide (continued)

New Leaf Growth to Pre-bloom: Disease Control (continued)

Pest/Problem	Management Options	Amount of Formulation per Acre	Effectiveness (+) or Importance (*)	REI	PHI	Comments (FRAC/IRAC Code)
Red stele; Phytophthora and Pythium crown/root rots	mefenoxam (Ridomil Gold EC)	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). FRAC-4
	Ultra Flourish	2 pt				
	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. FRAC-33
Botrytis	Remove dead and dying leaves just before bloom		**			Pruning leaves may suppress botrytis, especially in systems where fungicides are not used. Leaf removal does not appear economically beneficial where fungicides are used for botrytis management. If anthracnose fruit rot is present, hand-pruning plants creates more disease problems.

Strawberry Integrated Management Guide (continued)

Pre-harvest—Bloom: Insect Control

Pest/Problem	Management Options	Amount of Formulation per Acre	Effectiveness (+) or Importance (*)	REI	PHI	Comments (FRAC/IRAC Code)
<p>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.</p>						
Aphids	Aphids are infrequent pests 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.					
	imidacloprid (Admire Pro) (Provado)	10.5 to 14 oz 3.8 oz	+++	12 hr	14 days 7 days	Apply through irrigation. Provado is a foliar formulation. DO NOT apply when bees are foraging or within 10 days of bloom. IRAC-4A
	malathion (several products) 57 EC	1.5 pt	++	12 hr	3 days	DO NOT apply when bees are foraging. IRAC-1B
	thiamethoxam (Platinum) (Actara)	1.7 to 4.01 oz 1.5 to 3.0 oz	++	12 hr	50 days 3 days	Apply Platinum at transplant or through irrigation. 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. IRAC-4A
	insecticidal soap (M-Pede)	1 to 2 gal per 100 gal	+	12 hr	0 days	Very thorough coverage is needed. Use with caution; plant damage has been noted under some weather conditions.
Cutworms	carbaryl (Sevin) WSP 50 WP 4 XLR	2.5 lb 4 lb 1 to 2 qt	++	12 hr	7 days	Repeated use of carbaryl may cause spider mite problems. Cutworms are usually more of a problem in matted-row culture. Apply late in the day when plants clipped at the base are first noticed. DO NOT apply when bees are foraging. IRAC-1A
	fenpropathrin (Danitol) 2.4 EC	10.67 to 21.33 fl oz	+++	24 hr	2 days	DO NOT make more than 2 applications. Apply in at least 100 gal of water per acre. DO NOT apply when bees are foraging. IRAC-3A
	spinosad (Entrust, SpinTor)	1.25 to 1 oz 4 to 6 oz	++	4 hr	1 day	Rotate to a different class of insect control products after an application of Entrust. Do not make more than 5 applications/year. Do not apply more than 9 oz of Entrust (0.45 a.i. of spinosad) per acre per crop. Entrust is OMRI listed. IRAC-5

Strawberry Integrated Management Guide (continued)

Pre-harvest—Bloom: Insect Control (continued)

Pest/Problem	Management Options	Amount of Formulation per Acre	Effectiveness (+) or Importance (*)	REI	PHI	Comments (FRAC/IRAC Code)
Cutworms (continued)	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. IRAC-1B
	<i>Bacillus thuringiensis</i> (Bt) numerous products	rates vary	++			Many Bt formulations are OMRI listed. IRAC-11.
Flower thrips	spinosad (SpinTor) (Entrust)	4 to 6 oz 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 29 oz (Spintor) or 9 oz (Entrust) per acre per crop. Entrust is OMRI listed. IRAC-5
	Spinetoram (Radiant) SC	6 to 10 fl oz	++	4 hr	1 day	IRAC-5
Red 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. IRAC-7C
	methoprene (Extinguish Ant Bait) 0.5 % B	1 to 1.5 lb	+++	4 hr	0 day	Esteem and Extinguish are insect growth regulators (IGR) and act on the reproductive activity of the queen(s). Allow three 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 NOT labeled for use on cropland. Read labels carefully. IRAC-7A
	spinosad (Seduce Insect Bait)	20 to 44 lb (0.5 to 1 lb/ft ²)	+++	4 hrs	1 day	Do not make more than 5 applications per calendar year. IRAC-5
Slugs and snails	carbaryl (Sevin) 5 Bait	40 lb	+	12 hr	7 days	Apply bait to edges of beds at dusk. DO NOT contaminate fruit. Repeated applications are necessary. Controls many soil dwelling insects. IRAC-1A

Strawberry Integrated Management Guide (continued)

Pre-harvest—Bloom: Insect Control (continued)

Pest/Problem	Management Options	Amount of Formulation per Acre	Effectiveness (+) or Importance (*)	REI	PHI	Comments (FRAC/IRAC Code)
Slugs and snails (continued)	metaldehyde 4% Bait (Deadline Bullets)	30 to 60 lb	++	12 hr	6 days	Band around the edges of beds. DO NOT contaminate edible part of crop. IRAC-UN
	metaldehyde 4 % Bait (Deadline Bullets)	30 to 60 lb	++	12 hr	6 days	Band around the edges of beds. DO NOT contaminate edible part of crop. IRAC-UN
	Iron phosphate (Sluggo Snail and Slug Bait)	20 to 44 lb	++	0 hr	0 days	Apply in the evening. Some iron phosphate formulations are OMRI listed, check the label.
Strawberry clippers	Bifenthrin (Brigade 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. IRAC-3A
	carbaryl (Sevin) 80 S, WSP 50 WP 4 XLR	1.25 to 2.5 lb 2 to 4 lb 1 to 2 qt	++	12 hr	7 days	Repeated use of carbaryl may cause spider mite problems. DO NOT apply when bees are foraging. IRAC-1A
	fenpropathrin (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. IRAC-3A
Tarnished plant bugs	bifenthrin (Brigade) 10WSB	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. IRAC-3A
	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. IRAC-3A
	novaluron (Rimon) 0.83 EC	9 to 12 fl oz	++	12 hrs	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
Twospotted spider mites	See Post-planting: Insect Control recommendations					

Strawberry Integrated Management Guide (continued)

Pre-harvest—Early Bloom (10%) and into Harvest: Disease Control

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

1. Abound, Cabrio, and Pristine belong to the same family of chemicals (QoI; Group 11 chemistry). In 2009 and 2010, we have documented reduced activity with azoxystrobin (Abound) with certain strains of the anthracnose ripe fruit (ARF) rot pathogen. Pyraclostrobin (Cabrio/Pristine) has offered better control of ARF in recent research efforts. No more than 2 sequential applications of a Group 11 fungicide should be made before alternating with fungicides that have a different mode of action. Do not apply a Group 11 fungicide more than 1/3 the total number of sprays, if used alone, and no more than 50% of the total applications if mixed with a partner (for example, Captan). Typically this number is 3 and 4 applications, respectively. Pristine also has a second chemical (boscalid) 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.
3. Elevate may be not be used in more than 2 consecutive sprays. It is very good against Botrytis but nothing else.
4. CaptEstate is a premix of Captan and Elevate and when combined has good broad-spectrum activity.
5. 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 ripe fruit rot control.
6. 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.

For growers who adopt a conservative (low risk) fungicide program, apply sprays every 7 to 10 days according to **ONE** of the following suggested schedules.

SCHEDULE 1. For cases when there is no risk of anthracnose and growers need to focus on gray mold control (most fields):

Application 1: At 10 % bloom apply Captan + Topsin-M OR Switch.

Application 2: Apply Elevate OR Pristine.

Application 3: Same as Application 1 if there is a “full-bloom” situation.

Application 4 and weekly: Rotate two or more of the following: Captan; CaptEstate; Elevate; Switch; Pristine.

Options: For a reduced fungicide program, initiate applications at 10% bloom as above but apply subsequent sprays before predicted wet weather that favors Botrytis; and 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.

SCHEDULE 2. For cases where anthracnose fruit rot risk is high and gray mold control is also needed:

Application 1: At 10 % bloom apply Pristine.

Application 2: Apply ONE of these three alternatives: (1) CaptEstate OR (2) Switch OR (3) Captan.

Application 3: Same as Application 1.

Application 4 and weekly: Rotate two or more of the following: Captan; Elevate + (Abound or Cabrio); Pristine; Switch + (Abound or Cabrio).

In other words, there should be continuous coverage with Captan or a QoI, or the combination. Follow **key principle 1** above. During periods of cool wet weather and during bloom, incorporate Elevate or Switch for better Botrytis control. Pristine shows the best efficacy under high anthracnose pressure in our studies.

Strawberry Integrated Management Guide (continued)

Pre-harvest—Early Bloom (10%) and into Harvest: Disease Control (continued)

Pest/Problem	Management Options	Amount of Formulation per Acre	Effectiveness (+) or Importance (*)	REI	PHI	Comments (FRAC/IRAC Code)
Botrytis blight	Captan 50W or Captain 80WDG or	1.5 to 3 lb active ingredient	+++	1 day	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. FRAC-M4
	Captec 4L or	2.5 qt	+++	1 day	1 day	
	Topsin-M 70WP* or	1 lb	++++	12 hr	1 day	See note above (page 2) on resistance management. Research has demonstrated Topsin-M is helpful if used one to two times, after which resistant populations seem to predominate. FRAC-1
	Thiram 65WP or	4 to 5 lb	+++	1 day	3 days	Make 3 to 5 applications at 10-day intervals. Thiram is a broad spectrum fungicide similar to Captan. FRAC-M3
	Elevate 50WDG or	1.5 lb	+++++	4 hr	0 days	Do not apply more than 6 pounds of Elevate per season per acre. Avoid making more than 2 consecutive applications. After the second application, use an alternative botrytis material for 2 consecutive applications before reapplying Elevate. Under light pressure, reduced rates plus Captan may be used (see label). FRAC-17
	Switch 62.5WG* or	11 to 14 oz	+++++	12 hr	0 days	Begin application at or before bloom and continue on a 7-10 day interval. Do not exceed 56 ounces of product per acre per year. Follow the label concerning rotational crop waiting periods. FRAC-12, FRAC-9
	CaptEvote 68 WDG or	3.5 to 5.25 lb	+++++	24 hr	0 days	CaptEvote 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. FRAC-M4, FRAC-17
	Scala	18 fl oz or 9 fl oz	+++	12	24	Use lower rate only in a tank mix with another fungicide active against gray mold (e.g. Captan or Thiram). FRAC-12

Strawberry Integrated Management Guide (continued)

Pre-harvest—Early Bloom (10%) and into Harvest: Disease Control (continued)

Pest/Problem	Management Options	Amount of Formulation per Acre	Effectiveness (+) or Importance (*)	REI	PHI	Comments (FRAC/IRAC Code)
Botrytis blight and Anthracnose	Pristine WG**	18.5 to 23 oz	+++++	12 hr	0 days	No more than 2 sequential applications of Pristine should be made before alternating with fungicides that have a different mode of action. Do not apply more than 5 applications of Pristine per acre per crop year. FRAC–11, FRAC–7
	Captan 50W or Captan 80 WDG	1.5 to 3 lb active ingredient	+++	1 day	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. FRAC–M4
Anthracnose	Abound 2.08 F	6.2 to 15.4 fl oz	+++ (failure found in some fields)	4 hr	4 hr	See notes on page 17 to manage risk of developing fungicide resistance. In recent research, Abound has performed less well than Cabrio/Pristine. FRAC–11
	Pristine WG	18.5 to 23.0 oz	++++	12 hr	0 days	See notes on page 17 to manage risk of developing fungicide resistance. FRAC–11, FRAC–7
	Cabrio EG	12.0 to 14.0 oz	++++	12 hr	0 days	See notes on page 17 to manage risk of developing fungicide resistance. FRAC–11
Powdery mildew (only)	Procure 50WS	4.0 to 8.0 oz	+++++	12 hr	1 day	Do not plant leafy vegetables within 30 days after application. Do not plant root vegetables within 60 days after application. Rotation to all other crops within 1 year after application, unless Procure is registered for use on those crops, is prohibited. FRAC–3
	Procure 480SC	4.0 to 8.0 fl oz				
	Rally 40WSP	2.5 to 5.0 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. FRAC–3
	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. FRAC–13

Strawberry Integrated Management Guide (continued)

Pre-harvest—Early Bloom (10%) and into Harvest: Disease Control (continued)

Pest/Problem	Management Options	Amount of Formulation per Acre	Effectiveness (+) or Importance (*)	REI	PHI	Comments (FRAC/IRAC Code)
Powdery mildew and Anthracnose	Abound 2.08 F	6.2 to 15.4 fl oz	++++	4 hr	4 hr	See notes on page 17 to manage risk of developing fungicide resistance. FRAC-11
	Pristine WG	18.5 to 23.0 oz	++++	12 hr	0 days	See notes on page 17 to manage risk of developing fungicide resistance. FRAC -11, FRAC-7
	Cabrio EG	12.0 to 14.0 oz	++++	12 hr	0 days	See notes on page 17 to manage risk of developing fungicide resistance. DO NOT EXCEED 1.5 QT/YEAR. FRAC-11
Red stele; Phytophthora and Pythium crown/root rots	mefenoxam (Ridomil Gold EC)	1.0 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). FRAC-4
	(Ultra Flourish)	2.0 pt				
	Phosphates e.g., Aliette ProPhyt, Phostrol	Various rates, see label	++	12 hr	0 days	The phosphate-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. FRAC-33
Angular (bacterial) leaf spot	Basic copper sulfate or	2 to 3 lb/100 gal	+	1 day	12 hr	In most cases angular (bacterial) leaf spot will dry up during warmer weather. However, if cool wet weather persists during bloom and fruit development, the pathogen can colonize the calyx and cause a brown discoloration. These compounds provide some control if started prior to such predicted weather patterns. Repeat applications at 7- to 10-day intervals. Discontinue when phytotoxicity appears, usually after 4 to 5 applications. NOTE: All copper sulfate and copper hydroxide products labeled for strawberry can be used, but check label for the proper rate because different products will contain different percentages of active ingredient. All copper materials are FRAC-11.
	KOP 300 or	2 gal/100 gal	+	12 hr	2 days	
	Champion 77WP or	2 to 3 lb	+	2 days	2 days	
	Champion 2F or	1 to 2 pt	+	2 days	2 days	
	Kocide 101 or	2 to 3 lb	+	1 day	1 day	
	KOP-Hydroxide	2 to 4 pt/100 gal	+	2 days	2 days	

Strawberry Integrated Management Guide (continued)

Pre-harvest—Early Bloom (10%) and into Harvest: Disease Control (continued)

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

Pesticide	Relative Control Rating											
	Anthraco- nose (crown rot)	Anthraco- nose (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)	++	+	+	+	+	—	+++	—	—	—	—	—
pyraclostrobin (Cabrio)	++	+++	+	+	+	—	+++	—	—	—	—	—
pyraclostrobin + boscalid (Pristine)	++	+++	+++	+	+++	+++	—	?	?	—	—	—
captan (Captan)	++	++	++	—	++	+	+	+	+	—	—	—
copper	—	—	—	—	+ ^P	—	+ ^P	—	—	+ ^P	—	—
cyprodinil + fludioxinil (Switch)	++	+	+++	?	+?	+?	—	?	?	?	—	—
fenhexamide (Elevate)	—	—	+++	—	—	—	—	—	—	—	—	—
fenhexamide + captan (CaptEvote)	+	++	+++	—	++	+	+	+	+	—	—	—
fosetyl-AI (Aliette)	—	—	—	—	—	—	++	—	—	—	++	++
iprodione (Rovral)	—	—	+++ ^R	—	++	—	—	X	—	—	—	—
mefenoxam (Ridomil) or similar products	—	—	—	—	—	—	+++ ^R	—	—	—	+++	+++
myclobutanil (Nova)	—	—	—	+++ ^R	++ ^R	++ ^R	—	—	—	—	—	—
phosphites (Phostrol and others)	—	—	—	—	—	—	++	—	—	—	++	++

Strawberry Integrated Management Guide (continued)

Pre-harvest—Early Bloom (10%) and into Harvest: Disease Control (continued)

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
pyrimethanil (Scala)	—	—	++	—	—	—	—	—	—	—	—	—
sulfur	—	—	—	++ ^P	—	—	—	—	—	—	—	—
thiophanate-methyl (Topsin M)	++ ^R	—	++ ^R	+ ^R	++	++	—	X	—	—	—	—
thiram (Thiram)	++	++	++	—	+	+	+	+	+	—	—	—
triflumizole (Procure)	—	—	?	+++ ^R	?	?	—	—	—	—	—	—
azoxystrobin+propiconazole (QuiltXcel)	+++	++	—	—	—	—	—	—	—	—	—	—

^R = Not effective if pathogen is resistant to the fungicide.

^P = Phytotoxicity could occur.

X = Chemical use increases problem.

Strawberry Integrated Management Guide (continued)

Harvest: Insect Control

Pest/Problem	Management Options	Amount of Formulation per Acre	Effectiveness (+) or Importance (*)	REI	PHI	Comments (FRAC/IRAC Code)
Aphids	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. IRAC-3A
	thiamethoxam (Actara)	1.5 to 3.0 oz	+++	12 hr	3 days	Do not apply more than 12 oz/acre Actara; allow 10 days between applications. IRAC-4A
	insecticidal soap (M-Pede)	1 to 2 gal per 100 gal	+	12 hr	0 days	Very thorough coverage is needed. Use with caution; plant damage has been noted under some weather conditions.
	malathion (several products) 57 EC	1.5 pt	+	12 hr	3 days	DO NOT apply when bees are foraging. IRAC-1B
	imidacloprid (Provado) 1.6 F	3.8 oz	+++	12 hr	7 days	DO NOT apply when bees are foraging or within 10 days of bloom. IRAC-4A
Leaf rolling caterpillars	spinetoram (Radiant) SC	6 to 10 fl oz	++	4 hr	1 day	IRAC-5
	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 OMRI listed. IRAC-5
	carbaryl (Sevin) 80 S, WSP 50 WP 4 XLR	1.25 lb 2 lb 1 to 2 qt	++	12 hr	7 days	If noted during harvest, treat when more than 2 larvae per plant are found. DO NOT apply when bees are foraging. IRAC-1A
	malathion (several products) 57 EC	1.5 pt	+	12 hr	3 days	DO NOT apply when bees are foraging. IRAC-1B

Strawberry Integrated Management Guide (continued)

Harvest: Insect Control (continued)

Pest/Problem	Management Options	Amount of Formulation per Acre	Effectiveness (+) or Importance (*)	REI	PHI	Comments (FRAC/IRAC Code)
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 with sap beetles. Sap beetles can also be attracted away from fields by 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 for sap beetles should only be used if thorough harvest is not possible (i.e., pick-your-own operations or in case of inclement weather).
	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. IRAC-3A
	bifenthrin (Brigade) 10 WSB	6.4 to 32 oz	++	12 hr	0 days	DO NOT apply when bees are foraging. Refer to label. IRAC-3A
	novaluron (Rimon) 0.83 EC	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 surfacts is prohibited. IRAC-15
Slugs and snails	Same as Bloom recommendations					
Spittlebugs	Spittlebugs are typically not economically significant pests and should only be treated if the foamy “spittle” mass they create is contaminating berries and interfering with harvest.					
	fenprothrin (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. IRAC-3A
	malathion (several products) 57 EC	1.5 pt	+	12 hr	3 days	DO NOT apply when bees are foraging. IRAC-1B

Strawberry Integrated Management Guide (continued)

Harvest: Insect Control (continued)

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. IRAC-3A
	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. IRAC-3A
	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 surfacts is prohibited. IRAC-15
Twospotted spider mites	Same as Post-planting: Insect Control recommendations.					
Whiteflies	imidacloprid (Provado) 1.6 F	3.8 oz	+++	12 hr	7 days	DO NOT apply when bees are foraging.. IRAC-4A
	malathion (several products) 57 EC	1.5 pt		12 hr	3 days	DO NOT apply when bees are foraging. IRAC-1B
	fenpropathrin (Danitol) 2.4 EC	10.67 fl oz	++	24 hr	3 days	DO NOT make more than 2 applications. DO NOT apply when bees are foraging. IRAC-3A
	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. IRAC-23
	thiamethoxam (Actara)	3.0 to 4.0 oz	++	12 hr	3 days	Do not apply more than 12 oz/acre Actara; allow 10 days between applications. IRAC-4A

Strawberry Integrated Management Guide—Weed Control

Plasticulture Weed Control: Pre-planting					
Weed/Timing	Material	Amount of Formulation per Acre	Crop Age Restrictions	REI	Comments
Annual broadleaf weeds, including Carolina geranium and cutleaf evening primrose	oxyfluorfen (Goal) 2 XL	1 to 2 pt	Apply to soil surface of preformed 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.
	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	For best results avoid soil disturbance during application of plastic and planting of crop. Limited research has been conducted in North Carolina with Ultra Blazer.
	flumioxazin (Chateau) 51 WDG	3 oz	Apply to soil surface of preformed beds at least 30 days before transplanting.	12 hr	Apply a minimum of 30 days prior to transplanting and prior to plastic mulch being laid. Apply as part of a tank mix to control emerged weeds. Limited research has been conducted in North Carolina. In research conducted in North Carolina occasionally minimal crop injury has been observed with the 3 oz rate of Chateau. Yields have been reduced with rates above the registered rate of 3 oz. DO NOT USE ABOVE REGISTERED RATE, OF 3 OZ.
Broadleaf weeds	napropamide (Devrinol) 2 EC 50 DF	8 qt 8 lb	Apply to soil surface of preformed 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 hours 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. Lay the plastic mulch over the treated soil the same day as the application with Devrinol.

Strawberry Integrated Management Guide (continued)

Plasticulture Weed Control: Pre-planting (continued)

Weed/Timing	Material	Amount of Formulation per Acre	Crop Age Restrictions	REI	Comments
Annual grasses and broadleaf weeds	methyl bromide Various brands and concentrations	240 lb active ingredient	Apply at least 2 weeks prior to planting.	48 hr see label for detail	Inject into soil at a depth of 4 to 6 inches and cover with a tarp. Soil moisture should be near field capacity and soil temperature should be at least 50° F. Allow 2 weeks after application before transplanting. Disking after tarp removal will facilitate aeration.

Plasticulture Weed Control: Pre-emergence

Weed/Timing	Material	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 with a shielded sprayer to middles between plastic.	48 hr	DO NOT ALLOW ULTRA BLAZER TO CONTACT STRAWBERRY PLANTS. Limited research has been conducted with Ultra Blazer.
	flumioxazin (Chateau) 51 WDG	3 oz	Apply with a hooded or shielded sprayer to middles between plastic.	12 hr	Apply for pre-emergence 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.
Annual grasses and small seeded broadleaf weeds	napropamide (Devrinol) 2 EC 50 DF	8 qt 8 lb	Direct to middles between plastic.	12 hr	Apply as a banded application to the middles between plastic prior to weed emergence. Rainfall or irrigation within 24 hours is needed for optimum weed control. Effective on volunteer small grains (wheat etc.) if applied prior to emergence. DO NOT apply between bloom and harvest.

Strawberry Integrated Management Guide (continued)

Plasticulture Weed Control: Post-emergence

Weed/Timing	Material	Amount of Formulation per Acre	Crop Age Restrictions	REI	Comments
Annual broadleaf weeds	carfentrazone (Aim) 2 EC	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 in. tall or rosettes less than 3 in. across. Coverage is essential for good weed control. Does not control grass weeds.
Nonselective weed control	glyphosate (Roundup) (WeatherMax) 5.5 SL	11 to 22 oz	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 (Firestorm, Parazone) 3 SL (Gramoxone Inteon) 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 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.
Broadleaf weeds including ragweed, clover, vetch, dock, cocklebur, dandelion, sowthistle, thistle, red sorrel, and nightshade.	clopyralid (Stinger) 3 EC	Crop row: 0.33 to 0.5 pt Row middles: 0.33 to 0.67 pt	Apply after strawberry plants are established and at least 30 days before harvest.	12 hr	The Stinger use in strawberry is issued on a state-by-state basis; therefore, it may NOT be registered for use in all states using this guide. DO NOT apply within 30 days of harvest. DO NOT use a surfactant or apply in combination with other pesticides. 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 (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 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.

Strawberry Integrated Management Guide (continued)

Plasticulture Weed Control: Post-emergence (continued)

Weed/Timing	Material	Amount of Formulation per Acre	Crop Age Restrictions	REI	Comments
Annual and perennial grasses (continued)	sethoxydim (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 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 per acre per year.

Strawberry Integrated Management Guide (continued)

Matted Row Weed Control: Pre-planting

Weed/Timing	Material	Amount of Formulation per Acre	Crop Age Restrictions	REI	Comments
Annual grass and broadleaf weeds	Fumigation—see tables above (page 2). Various brands and concentrations		See labels for plant-back intervals.	See label for detail.	See labels for rates, plant-back intervals, and personal protective equipment requirements.

Matted Row Weed Control: Pre-emergence

Weed/Timing	Material	Amount of Formulation per Acre	Crop Age Restrictions	REI	Comments
Annual grasses and small-seeded broadleaf weeds	DCPA (Dacthal) 6 L 75-W	8 to 12 pt 8 to 12 lb	Newly planted and established plantings before bloom	12 hr	Apply over the top of newly planted strawberries after transplanting. Apply to established plantings in the fall to early spring prior to bloom. Overhead irrigation or rainfall within 24 hr of application is necessary for activation.
	napropamide (Devrinol) 50 WDG 10 G 2 EC	8 lb 40 lb 8 qt	Established strawberries	12 hr	Apply any time prior to weed emergence except for the interval between bloom and harvests. Rainfall, overhead irrigation, or cultivation within 3 to 7 days is necessary for activation and optimum herbicide performance.
Annual broadleaf weeds and grasses	terbacil (Sinbar) 80 WP	2 to 6 oz or 4 to 8 oz	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 crop is not dormant, the application must be followed immediately by 0.5 to 1 in. of overhead irrigation. 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 and before new growth begins in mid-summer. For extended weed control through harvest the following year, apply 4 to 6 oz per acre prior to mulching in late fall. Do not apply within 110 days of harvest. See label for more information.

Strawberry Integrated Management Guide (continued)

Matted Row Weed Control: Post-emergence

Weed/Timing	Material	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	The Stinger use in strawberry is issued on a state-by-state basis. Therefore, it may NOT be registered for use in all states using this guide. 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.
Broadleaf weeds	2, 4-D amine (2, 4-D Amine) 4 SL	2 to 3 pt	Established plantings	48 hr	2, 4-D can be applied to established strawberry plants that are dormant or immediately after final harvest. Apply in a spray volume of 25 to 50 gallons per acre. DO NOT apply unless possible injury to the crop is acceptable.
Annual broadleaf weeds	acifluorfen (Ultra Blazer) 2 L	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. Limited research has been conducted in North Carolina with Ultra Blazer.
	flumioxazin (Chateau) 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.
Contact kill of all green foliage	paraquat (Firestorm, Parazone) 3 SL (Gramoxone Inteon) 2 L	1.3 pt 2.0 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.

Strawberry Integrated Management Guide (continued)

Matted Row Weed Control: Post-emergence (continued)

Weed/Timing	Material	Amount of Formulation per Acre	Crop Age Restrictions	REI	Comments
Annual and perennial grasses	clethodim (Select, Arrow) 2 EC (Select Max) 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 (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 (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.