Best Management Practices for Anthracnose Control

Kelly Ivors
Dept. Horticulture & Crop Science
Cal Poly (Strawberry Center)

Disease Diagnostics

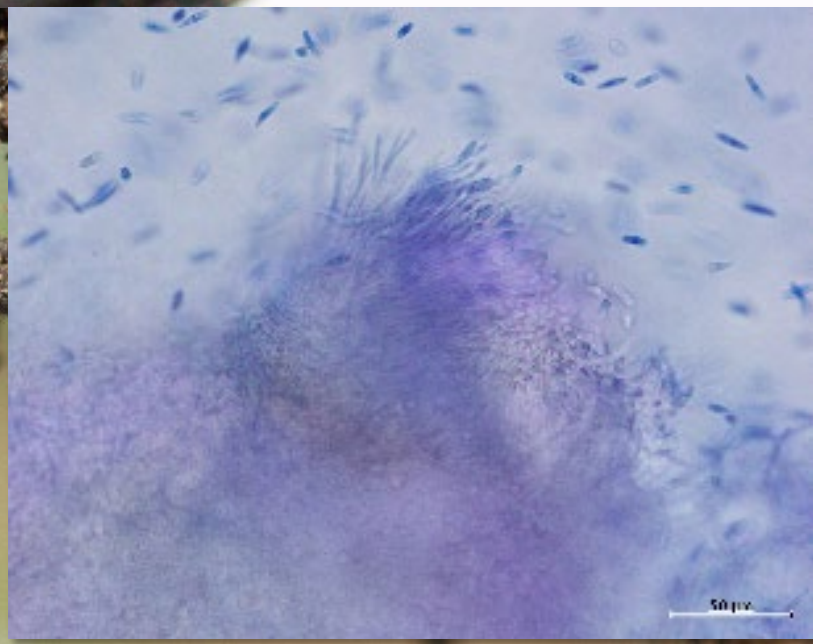
Anthracnose is one of the major disease concerns for growers this summer and fall planting season in Santa Maria and Oxnard growing regions

Summer Portola planting
Santa Maria, Sept 2015

Anthracnose…

- Anthracnose on strawberries is caused by multiple species of *Colletotrichum* (a fungus);
- Causes root rot, crown rot, fruit rot, flower blight, and lesions on stolons, petioles and leaves;
- Crown rot and fruit rot are the most important in California (& Florida).

Anthracnose crown rot, caused by *Colletotrichum acutatum*



Anthracnose root rot, caused by *Colletotrichum acutatum*

Natalia Peres, UFL

Anthracnose crown rot, caused by *C. acutatum*

Gerald Holmes, Strawberry Center

Anthracnose flower blight, caused by *C. acutatum*

Anthracnose fruit rot, caused by *C. acutatum*

Kelly Ivors, Cal Poly

Best Management Practice #1

Use pathogen-free plants

The use of pathogen-free transplants is the most important management strategy for controlling anthracnose.

STRAWBERRY: TREATMENT TIMING

Note: Not all indicated timings may be necessary for disease control.

		At Planting			Preharvest[1]	
Disease	**Preplant fumigation[2]**	**Clean nursery stock**	**Dips or water washing**	**Before overhead irrigations**	**Foliar**	**Fruit**
Anthracnose[3]	+++	+++	+++	+	+	+++
Botrytis fruit rot[3]	----	----	----	+	++	+++
Mucor fruit rot	----	----	----	+	+	+++
Rhizopus rot	----	----	----	----	----	+++
Angular leaf spot	+	+++	+	+++	+	----
Common leaf spot[3]	+	+++	+++	+++	+++	+
Powdery mildew[3]	----	+++	----	----	+++	+
Leather rot[4]	+++	----	----	++	----	++
Phytophthora crown rot[4]	+++	+	----	++	+	----
Red steele[4]	++	++	----	+	++	----
Verticillium wilt	+++	++	----	----	----	----

Rating: +++ = most effective, ++ = moderately effective, + = least effective, and ---- = ineffective.

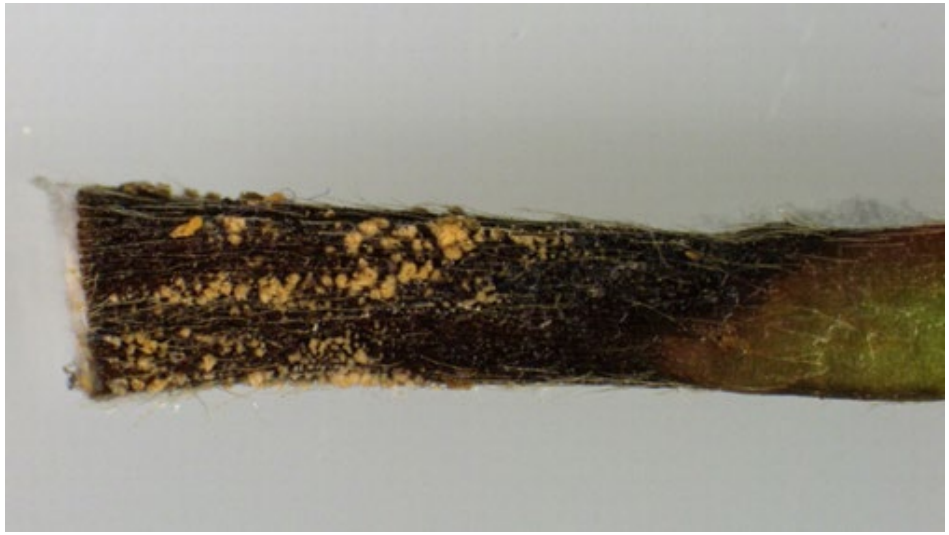
[1] Preharvest treatments include applications of fungicides before heavy fog, dews, or rain.

[2] Preplant fumigation includes methyl bromide/chloropicrin, 1,3-dichloropropene/chloropicrin or chloropicrin followed by metam sodium or metam potassium or solitary applications of 1,3-dichloropropene/chloropicrin or chloropicrin.

[3] Integrated programs required for management including rotation of fungicides of different classes.

[4] In-season foliar treatments include phosphite or fosetyl-aluminum products or soil applications

Colletotrichum survey 2016



Best Management Practice #1

Use pathogen-free plants

The use of pathogen-free transplants is the most important management strategy for controlling anthracnose.

Hopefully after fall 2016, anthracnose will be a 'thing' of the past… until then, it should be expected.

Best Management Practice #2

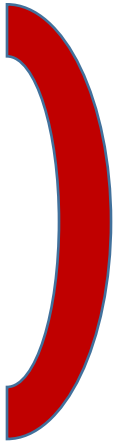
Use resistant/tolerant cultivars

Best Management Practice #2

Use resistant/tolerant cultivars

Unfortunately most summer plant cultivars are quite susceptible to anthracnose, as well as most other CVs.

Portola
1975
959
324
3024
Amado
Monterey



Cultivars we have isolated *C. acutatum* from

Best Management Practice #2

Use resistant/tolerant cultivars

Scale of 1 to 5; 5 being completely resistant

UC Breeding program ratings pre-2014

Cultivar	*C. acutatum* resistance
Camarosa	2.8
Ventana	3
Albion	3.1
Monterey	2.9
San Andreas	2.8
Portola	2.2
Palomar	3.1
Benicia	2.7
Merced	2.3
Petaluma	2.2
Grenada	1.9
Fronteras	2.5
Cabrillo	1.8

Best Management Practice #3

Avoid overhead irrigation

Keep foliage dry and reduce water splash by use of drip irrigation.

Best Management Practice #4

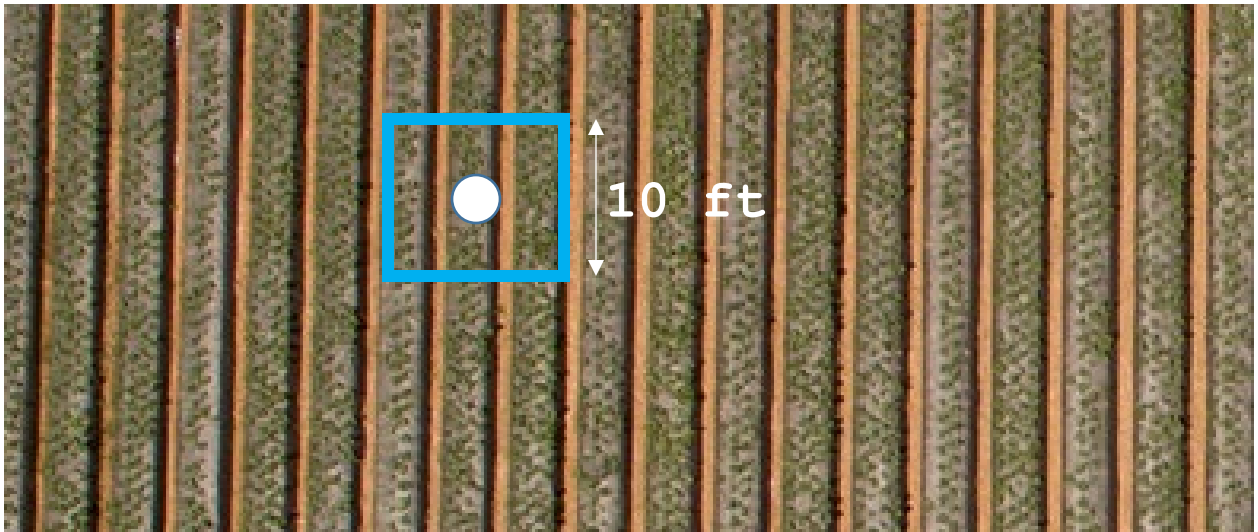
Scout for disease

Best Management Practice #4

Scout for disease

Periodic scouting, especially during warm and wet conditions, will enable early detection and prevention.

ORGANIC producers: Remove and destroy infected and surrounding plants within a 10 foot radius.



Best Management Practice #5

Fumigate or Rotate

STRAWBERRY: TREATMENT TIMING

Note: Not all indicated timings may be necessary for disease control.

			At Planting		Preharvest[1]	
Disease	**Preplant fumigation[2]**	**Clean nursery stock**	**Dips or water washing**	**Before overhead irrigations**	**Foliar**	**Fruit**
Anthracnose[3]	+++	+++	+++	+	+	+++
Botrytis fruit rot[3]	----	----	----	+	++	+++
Mucor fruit rot	----	----	----	+	+	+++
Rhizopus rot	----	----	----	----	----	+++
Angular leaf spot	+	+++	+	+++	+	----
Common leaf spot[3]	+	+++	+++	+++	+++	+
Powdery mildew[3]	----	+++	----	----	+++	+
Leather rot[4]	+++	----	----	++	----	++
Phytophthora crown rot[4]	+++	+	----	++	+	----
Red steele[4]	++	++	----	+	++	----
Verticillium wilt	+++	++	----	----	----	----

Rating: +++ = most effective, ++ = moderately effective, + = least effective, and ---- = ineffective.

[1] Preharvest treatments include applications of fungicides before heavy fog, dews, or rain.

[2] Preplant fumigation includes methyl bromide/chloropicrin, 1,3-dichloropropene/chloropicrin or chloropicrin followed by metam sodium or metam potassium or solitary applications of 1,3-dichloropropene/chloropicrin or chloropicrin.

[3] Integrated programs required for management including rotation of fungicides of different classes.

[4] In-season foliar treatments include phosphite or fosetyl-aluminum products or soil applications

Best Management Practice #5

Fumigate or Rotate

Strawberry Anthracnose: Detection and Survival of *Colletotrichum acutatum* in Soil

D. M. EASTBURN, Department of Plant Pathology, University of Illinois
and W. D. GUBLER, Department of Plant Pathology, University of Californ

---

ABSTRACT

Eastburn, D. M., and Gubler, W. D. 1990. Strawberry anthracnose: Detection and survival of *Colletotrichum acutatum* in soil. Plant Dis. 74:161-163.

Propagules of *Colletotrichum acutatum* were detected in soil from a recently fallowed strawberry nursery plot. A survey of strawberry nursery and production fields showed that *C. acutatum* was present in soils from sites with a recent history of strawberry anthracnose but not in fumigated soils. Isolates of *C. acutatum* from soil were culturally similar to isolates from plant tissue and were equally pathogenic in assays using detached fruit. Soil naturally infested with *C. acutatum* initiated disease development on strawberry plants in the greenhouse. *C. acutatum* survived in buried strawberry tissue for 9 mo, but soil population densities gradually declined over an 11-mo period. Results suggest that soilborne propagules, especially those in soil attached to planting stock, may be a source of inoculum in California.

Best Management Practice #5

Fumigate or Rotate

If anthracnose crown rot was detected in your field, you should fumigate before the next season's crop.

If this is not possible, rotate out of strawberries for one year.

Best Management Practice #6

Use pre-plant dip and foliar fungicides

STRAWBERRY: TREATMENT TIMING

Note: Not all indicated timings may be necessary for disease control.

			At Planting		Preharvest[1]	
Disease	**Preplant fumigation[2]**	**Clean nursery stock**	**Dips or water washing**	**Before overhead irrigations**	**Foliar**	**Fruit**
Anthracnose[3]	+++	+++	+++	+	+	+++
Botrytis fruit rot[3]	----	----	----	+	++	+++
Mucor fruit rot	----	----	----	+	+	+++
Rhizopus rot	----	----	----	----	----	+++
Angular leaf spot	+	+++	+	+++	+	----
Common leaf spot[3]	+	+++	+++	+++	+++	+
Powdery mildew[3]	----	+++	----	----	+++	+
Leather rot[4]	+++	----	----	++	----	++
Phytophthora crown rot[4]	+++	+	----	++	+	----
Red steele[4]	++	++	----	+	++	----
Verticillium wilt	+++	++	----	----	----	----

Rating: +++ = most effective, ++ = moderately effective, + = least effective, and ---- = ineffective.

[1] Preharvest treatments include applications of fungicides before heavy fog, dews, or rain.

[2] Preplant fumigation includes methyl bromide/chloropicrin, 1,3-dichloropropene/chloropicrin or chloropicrin followed by metam sodium or metam potassium or solitary applications of 1,3-dichloropropene/chloropicrin or chloropicrin.

[3] Integrated programs required for management including rotation of fungicides of different classes.

[4] In-season foliar treatments include phosphite or fosetyl-aluminum products or soil applications

Best Management Practice #6

Use pre-plant dip and foliar fungicides

A fungicide dip at planting is the most effective form of chemical control.

STRAWBERRY: TREATMENT TIMING

Note: Not all indicated timings may be necessary for disease control.

			At Planting		Preharvest[1]	
Disease	Preplant fumigation[2]	Clean nursery stock	Dips or water washing	Before overhead irrigations	Foliar	Fruit
Anthracnose[3]	+++	+++	+++	+	+	+++
Botrytis fruit rot[3]	----	----	----	+	++	+++
Mucor fruit rot	----	----	----	+	+	+++
Rhizopus rot	----	----	----	----	----	+++
Angular leaf spot	+	+++	+	+++	+	----
Common leaf spot[3]	+	+++	+++	+++	+++	+
Powdery mildew[3]	----	+++	----	----	+++	+
Leather rot[4]	+++	----	----	++	----	++
Phytophthora crown rot[4]	+++	+	----	++	+	----
Red steele[4]	++	++	----	+	++	----
Verticillium wilt	+++	++	----	----	----	----

Rating: +++ = most effective, ++ = moderately effective, + = least effective, and ---- = ineffective.

[1] Preharvest treatments include applications of fungicides before heavy fog, dews, or rain.

[2] Preplant fumigation includes methyl bromide/chloropicrin, 1,3-dichloropropene/chloropicrin or chloropicrin followed by metam sodium or metam potassium or solitary applications of 1,3-dichloropropene/chloropicrin or chloropicrin.

[3] Integrated programs required for management including rotation of fungicides of different classes.

[4] In-season foliar treatments include phosphite or fosetyl-aluminum products or soil applications

Best Management Practice #6

Use pre-plant dip and foliar fungicides

A fungicide dip at planting is the most effective form of chemical control.

Fungicide applications are critical during early and full bloom.

Best Management Practice #6

Use pre-plant dip and foliar fungicides

A fungicide dip at planting is the most effective form of chemical control.

Fungicide applications are critical during early and full bloom.

Applying a fungicide after symptoms occur on flowers and fruit will lead to poor control.

Fungicides for control of anthracnose of strawberry in California

Gerald Holmes and Kelly Ivors, Cal Poly Strawberry Center

Product	Active ingredient/s	FRAC	efficacy rating	Field type*		Application method	
				Nursery	Fruit production	Dip	Foliar
Conventional							
Abound	azoxystrobin	11	G	X	X	X	X
Avaris 2XS	azoxystrobin + propiconazole	11 + 3	G		X		X
Cabrio	pyraclostrobin	11	G		X		X
CaptEvate	captan + fenhexamid	M4 + 17	F	X	X		X
Evito	fluoxastrobin	11	G	X	X		X
Flint	trifloxystrobin	11	G	X	X		X
Kenja 400	isofetamid	7	?	X	X		X
Luna Sensation	fluopyram + trifloxystrobin	7 + 11	?	X	X		X
Merivon	fluxapyroxad + pyraclostrobin	7 + 11	G		X		X
Oso**	polyoxin-D	19	?	X	X		X
Pristine	boscalid + pyraclostrobin	7 + 11	G		X		X
Quadris Top	azoxystrobin + difenaconazole	11 + 3	G	X	X		X
Quilt Xcel	azoxystrobin + propiconazole	11 + 3	G		X		X
Rovral**	iprodione	2	?	X	X		X
Switch	cyprodinil + fludioxonil	9 + 12	G	X	X	X	X
Tilt	propiconazole	3	F	X	X		X
Biological							
Actinovate***	S. lydicus		P	X	X		X
Double Nickle LC	B. amyloliquefaciens		P	X	X		X
Regalia	extract of R. sachalinensis		P	X	X		X
Serenade ASO	B. subtilis		P	X	X		X

G= Good; F= Fair; P= Poor in effectiveness

* These fungicide guidelines are for field production and do not include greenhouse cultivation of strawberry.

** Suppression only.

*** In the process of getting registered as a dip in California.

While labeled on strawberry, Bravo Weather Stik, Topsin, and Thiram are not labeled for the control of anthracnose in California.

AZOXYSTROBIN RESISTANCE

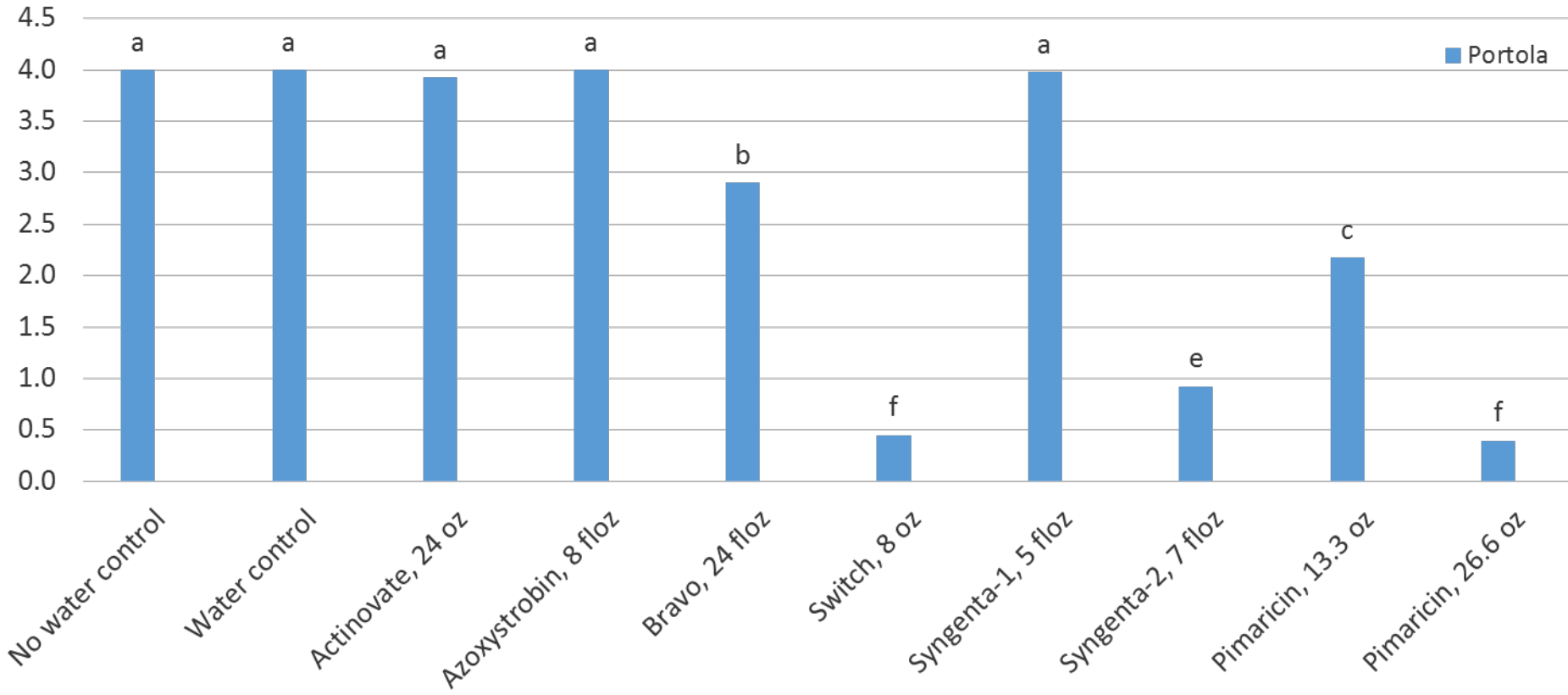
- 119 nursery & field isolates tested for resistance to azoxystrobin
  (a.i. in Abound and Quilt Xcel; similar chemistry to pyraclostrobin, the a.i. in Cabrio, Pristine and Merivon).

- Azoxystrobin resistance detected in isolates from only one source; 77% of these isolates were resistant.

AZOXYSTROBIN RESISTANCE

Anthracnose severity (0-4)

(artificial inoculation – azoxystrobin resistant strain)



Best Management Practice #6

Use pre-plant dip and foliar fungicides

A fungicide dip at planting is the most effective form of chemical control.

Fungicide applications are critical during early and full bloom.

Applying a fungicide after symptoms occur on flowers and fruit will lead to poor control.

There are NO OMRI certified products that provide effective control of anthracnose.

Materials posted at:
www.strawberry.calpoly.edu