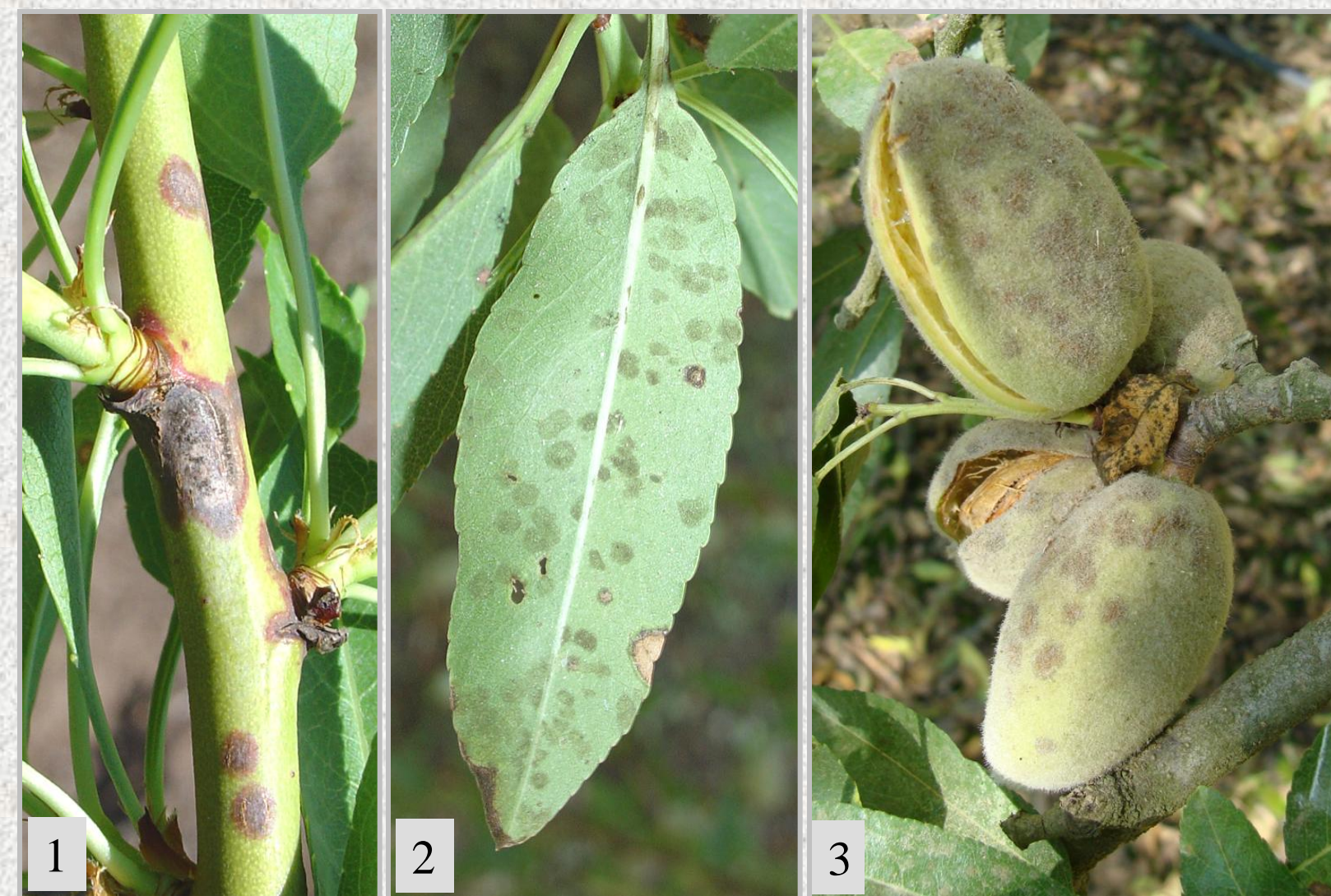


# Epidemiology and Control of Almond Scab and Alternaria Leaf Spot

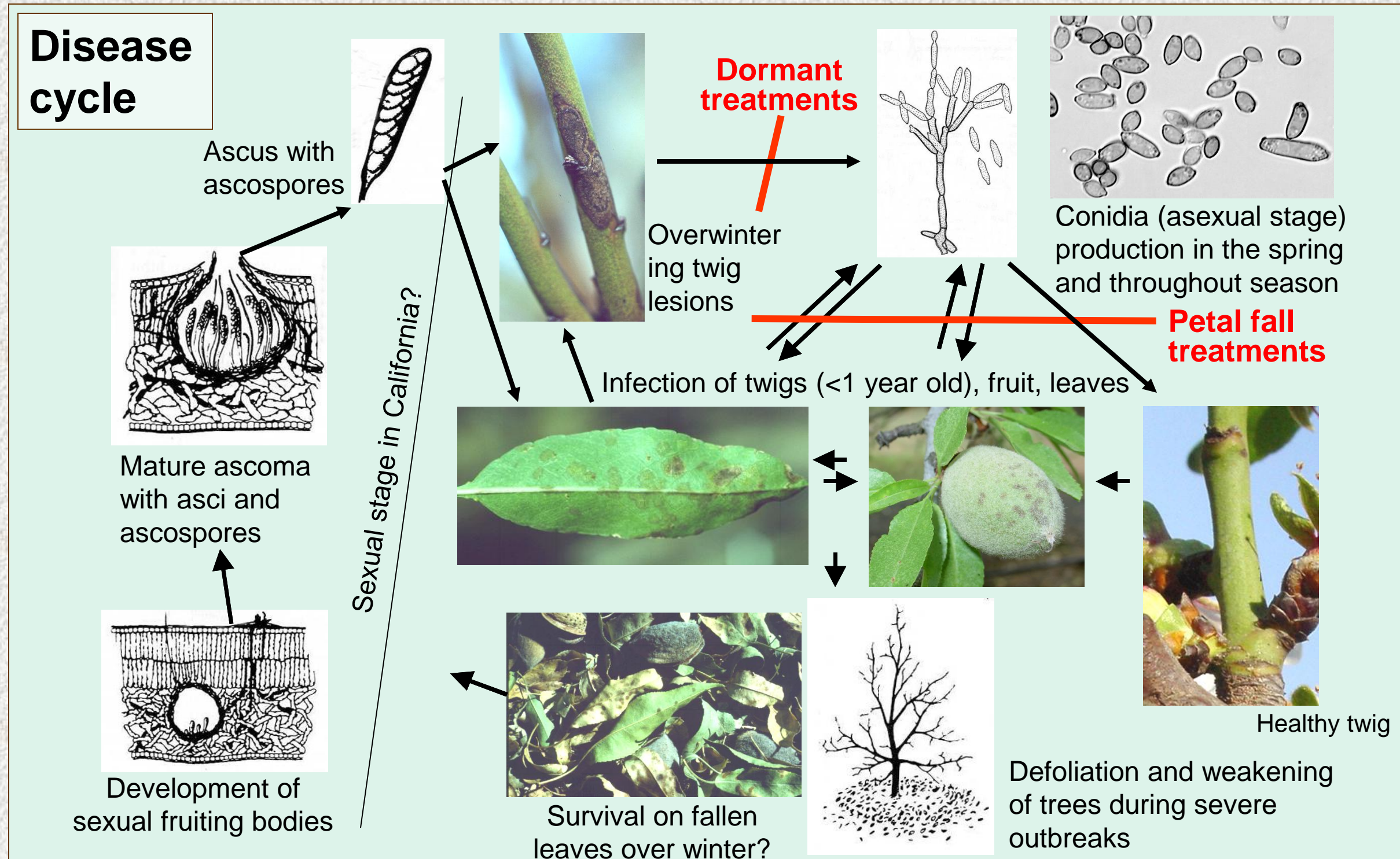
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## Management of Scab (*Fusicladium carpophilum*)



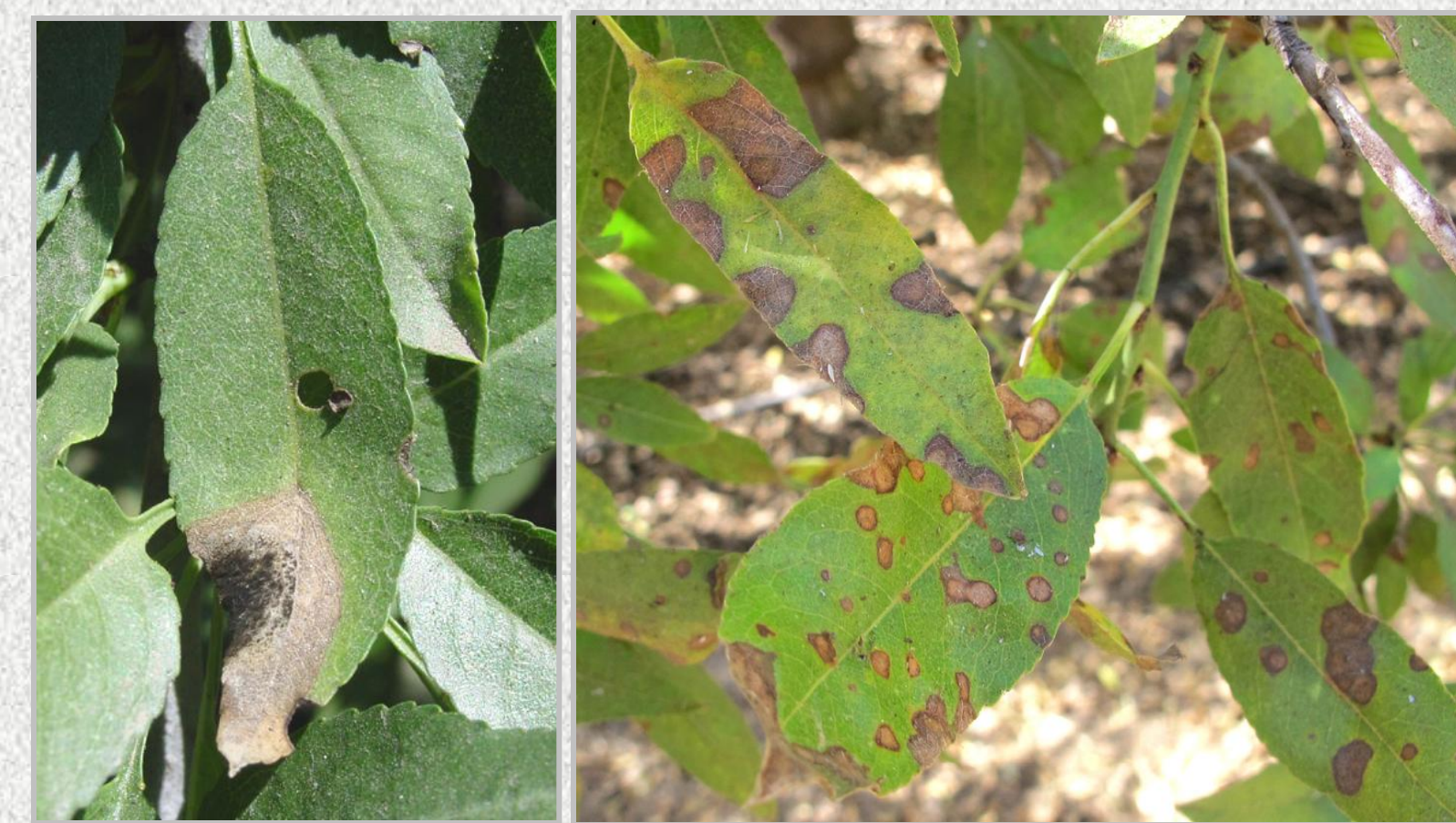
1) Sporulation on twig lesion; 2) Leaf and 3) fruit symptoms.



## Management of Alternaria Leaf Spot (*Alternaria* spp.)



Conidia of *Alternaria* sp.



Sporulating lesion.

Necrotic leaf lesions.



Early tree defoliation and new leaf development eventually weakens the tree.

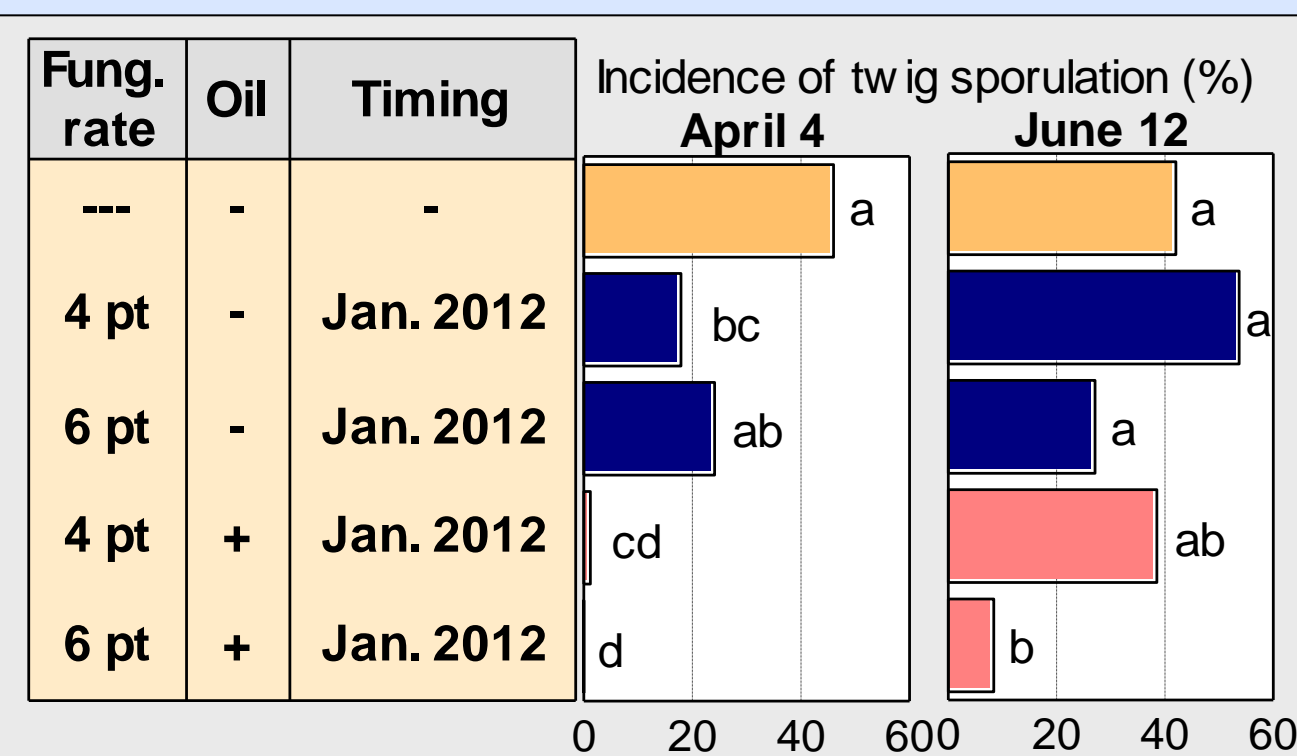


Drop of infected leaves

## Field trials on disease management in 2012

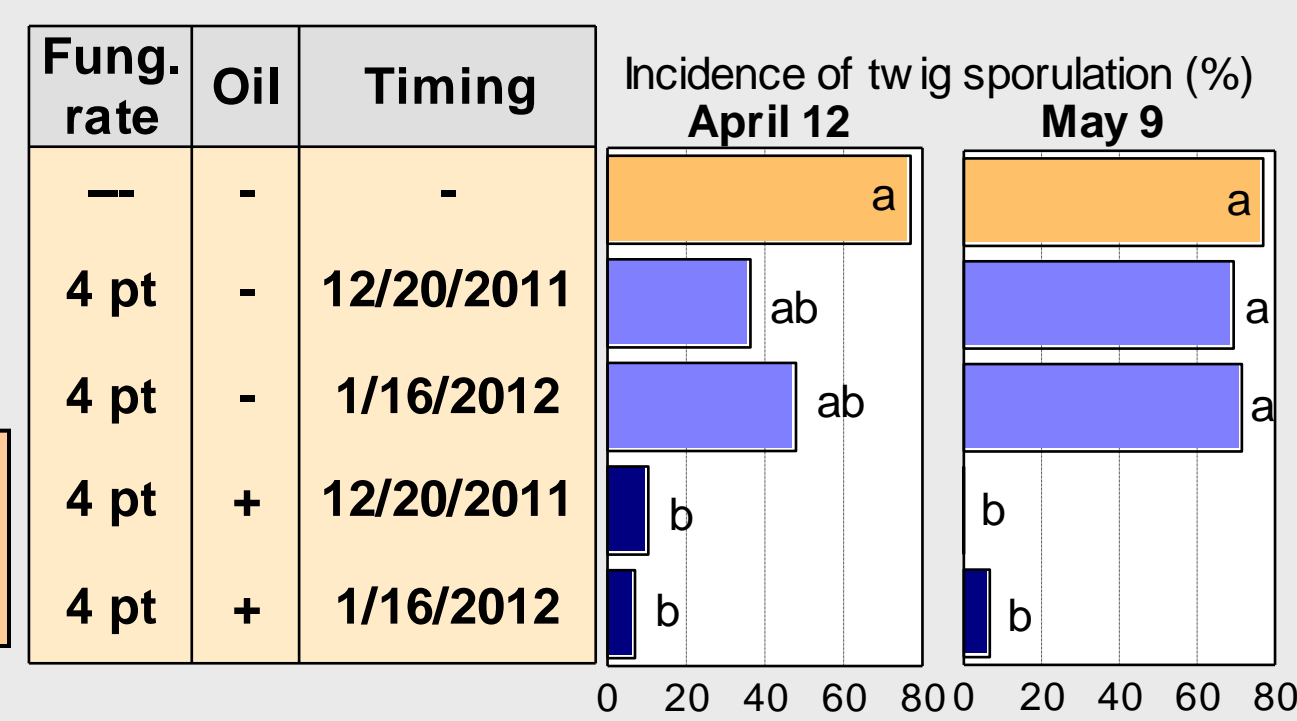
### 1. Dormant applications with chlorothalonil to reduce inoculum in the spring

Bravo WeatherStik on cv. Carmel, Butte Co. Application Jan 2012



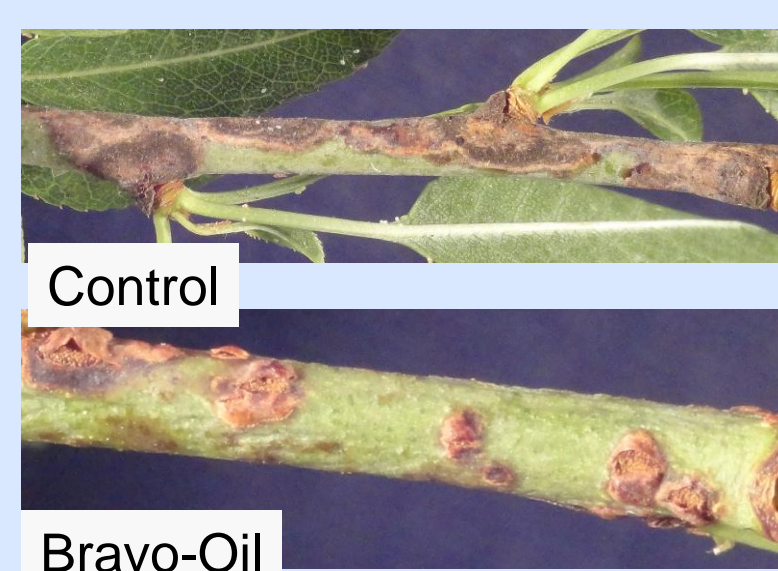
1. Higher rate of chlorothalonil-oil provided protection into late spring.

Bravo WeatherStik on cv. Monterey, Kern Co.



2. Oil improved performance regardless of timing

- In comparative trials in 2011, chlorothalonil was more effective than copper.
- The 6-pt rate of Bravo WeatherStik was more effective than the 4-pt rate.
- In combination with 4% oil, the efficacy of chlorothalonil was greatly improved and was extended into late spring.



- Dormant applications can be highly effective in reducing and delaying production of primary inoculum and in delaying start of disease progression..
- This may allow to synchronize scab with Alternaria treatment timings.

### ALMOND - Treatment timing for scab and Alternaria

Disease	Dormant	Bloom			Spring		Summer	
		Pink bud	Full bloom	Petal fall	Two week	Five week	May	June
Scab	++	-	-	+	+++	+++	+/-	+/-
Scab Dormant chlorothalonil	++	-	-	-	-	+++	+++	+/-
Alternaria	-	-	-	-	-	+++	+++	+++

In October of 2012, Bravo WeatherStik received a Section 2(ee) registration for dormant application between Dec. 1 and Jan. 10, 2013 or before bud swell using the 4-pt rate. Full registration is planned through IR-4 to change PHI to 60 days and rate to 6 pts/A.

### 2. In-season applications

Treatment	Rate (A)	4-18	5-22	4/18 & 5/22/12	5/22 & 6/12/12
Control	---	---	---	a	a
Bravo	4 pts/A	@	@	bc	a
Fontelis	14 fl oz	@	@	bc	ab
Quash + Ph-D*	3.5 oz + 6.2 oz	@	@	cd	c
Luna Sensation	5 fl oz	@	@	b	a
Inspire Super + Surf.	20 fl oz	@	@	d	bc
Quadris Top	14 fl oz	@	@	cd	c
Merivon	6.5 fl oz	@	@	bcd	a
Syllit	32 oz	@	---	cd	ab
Bumper	4 fl oz	---	@	---	---

cv. Carmel, Butte Co., 2012

The first in-season scab application has to be timed at initiation of twig lesion sporulation for best efficacy. For most fungicides, programs starting early (A) were more effective than later (B) applications.

Treatment*	Rate (A)	4/19	5/22	6/13	Inc. on fruit (%)	Severity rating
Control	---	---	---	---	a	a
Syllit	24 oz	@	@	@	abc	bc
Quash 50WG	3.5 oz	@	@	@	h	fgh
Topguard	14 fl oz	@	@	@	bcd	bcd
Quash + S2200	3 oz + 3 oz	@	@	@	hi	gh
Luna Sensation	5 fl oz	@	@	@	fgh	gh
Luna Experience	6 fl oz	@	@	@	efgh	defgh
Quadris Top	14 fl oz	@	@	@	i	h
Inspire Super + surf.	20 fl oz	@	@	@	gh	efgh
Pristine 38WG	14.5 oz	@	@	@	ab	b
Merivon	6.8 fl oz	@	@	@	efgh	efgh
LBG-61	40 fl oz	@	@	@	fgh	fgh
Catamaran	64 fl oz	@	@	@	defgh	defg

cv. Monterey - Colusa Co. 2012

New, highly effective fungicides are available:  
Single: Quash, PhD, Luna Sensation, Syllit (registered in Nov. 2012)  
Pre-mixtures: Quadris Top, Inspire Super, Merivon (scheduled for 2013)

### Summary: Management of scab with fungicides

- An effective 3-spray program includes dormant & two applications after twig infection sporulation.
- Multi-site fungicides with low resistance potential (chlorothalonil, possibly mancozeb, captan, ziram) should be in rotations with the newer single-site and pre-mix fungicides.
- Syllit is a new scab material and should be used at 32 oz/A.
- Single-site fungicides should not be applied once disease is developing.

Kern Co.

## Field trials on disease management 2012

Treatment	Rate (A)	5/8	5/30	6/20	Cv. Monterey		Cv. Fritz	
					Inc. (%)	Defoliation rating	Inc. (%)	Defoliation rating
Control	---	---	---	---	a	a	a	a
Ph-D 11.2D*	6.2 oz	@	@	@	bcd	cd	cde	bc
Quash 50WG	3 oz	@	@	@	cde	cdef	cde	c
Topguard	10 fl oz	@	@	@	bcd	cdef	de	bc
YT669 2.08SC*	12 fl oz	@	@	@	bc	cd	b	bc
Fontelis*	20 fl oz	@	@	@	bcd	def	cde	bc
Ph-D + Quash*	6.2 oz + 3 oz	@	@	@	def	f	cde	bc
Luna Experience	6 fl oz	@	@	@	cde	cde	cde	bc
Luna Sensation	5 fl oz	@	@	@	f	ef	e	bc
Inspire Super*	20 fl oz	@	@	@	ef	cdef	cde	bc
Quadris Top	14 fl oz	@	@	@	cde	cdef	de	bc
Q8Y78 240SC	24 fl oz	@	@	@	bcd	cdef	cde	bc
Merivon	4 fl oz	@	---	@	def	def	de	bc
Ph-D + Quash*	6.2 oz + 3 oz	---	@	---	---	---	---	---
Merivon	6.5 fl oz	@	---	@	def	ef	de	bc
Ph-D + Quash*	6.2 oz + 3 oz	---	@	---	---	---	---	---
Pristine	14.5 fl oz	@	---	@	bcd	def	bcde	bc
Ph-D + Quash*	6.2 oz + 3 oz	---	@	---	---	---	---	---

\* A non-ionic surfactant was added..

Evaluation of tree defoliation (August)



- ### Fungicide resistance:
- Resistance against QoIs is common, resistance against older SDHIs (i.e., boscalid) only at some locations at high levels.
  - Cross resistance within QoIs (Abound, Gem, etc.)
  - Newer SDHIs (FG 7B - fluopyram, FG 7F - fluxapyroxad, penthiopyrad) more effective than older ones (FG 7G - boscalid), but some cross-resistance occurs.

### Cross-resistance among SDHI sub-groups in isolates of *Alternaria* sp.

Cross resistance type	FG 7G (boscalid)	FG 7F (fluxapyroxad, penthiopyrad)	FG 7B (fluopyram)
1	R	S	S
2	R	MR	S
3	R	R	MR

S= Sensitive  
R= Resistance (EC<sub>50</sub> values >10x of baseline, >1 ppm)  
MR = Moderate resistance (EC<sub>50</sub> values 3 to <10 x of baseline, <1 ppm)

Treatment	Rate (A)	4-18	5-22	Inc. (%)	Defoliation rating
Control	---	---	---	a	a
Bravo	4 pts/A	@	@	b	b
Fontelis	14 fl oz	@	@	bc	b
Quash + Ph-D*	3.5 oz + 6.2 oz	@	@	bc	b
Luna Sensation	5 fl oz	@	@	c	b
Inspire Super + Surf.	20 fl oz	@	@	bc	b
Quadris Top	14 fl oz	@	@	c	b
Merivon	6.5 fl oz	@	@	bc	b
Syllit	32 oz	@	---	bc	b
Bumper	4 fl oz	---	@	---	---

### The modified DSV model for forecasting Alternaria leaf spot of almond

Mean temperature (C) during wetness	Leaf wetness duration (hours)				
15 - 17	0-6	7-15	16-20	21	---
17.1 - 20	0-3	4-8	9-15	16-22	23+
20.1 - 25	0-2	3-5	6-12	13-20	21+
25.1 - 29	0-3	4-8	9-15	16-20	23+
DSV	0	1	2	3	4

DSV is a function of leaf wetness and air temperature during the wetness period.  
Infection periods are defined by DSV values.

### Summary: Management of Alternaria Leaf Spot

- #### Most effective treatments:
- Mixtures of FRAC group (FG) 19 - Ph-D (polyoxin-D) and FG 3 fungicides (i.e., Inspire, Quash).
  - FG 7 - Fontelis (but high resistance potential when used alone)
  - Pre-mixtures FG 3/11: Adament, Quilt Excel, Quadris Top, FG 7/11 - Luna Sensation, Merivon (These all have a QoI component and thus, will exacerbate QoI resistance) and FG 3/9 - Inspire Super
  - Chlorothalonil is being developed because it has a multi-site MOA, and the label will be modified for 6 qt/A and 60 days PHI.
  - For FG 19 - polyoxin-D, an organic formulation is being developed.

### Fungicide programs\*:

- Programs should start with petal fall applications that include Rovral and Bravo (performance is variable and depends on the occurrence of favorable conditions).
  - Late-spring/early-summer applications (based on the DSV model) with newer materials with short PHIs.
  - New materials will have to be strictly used in rotations and mixtures for resistance management.
- Cultural components need to be in an integrated approach for disease management. This is highly critical for long-term management of Alternaria leaf spot.

\* Note: See second poster for fungicides registered and being evaluated on almond.