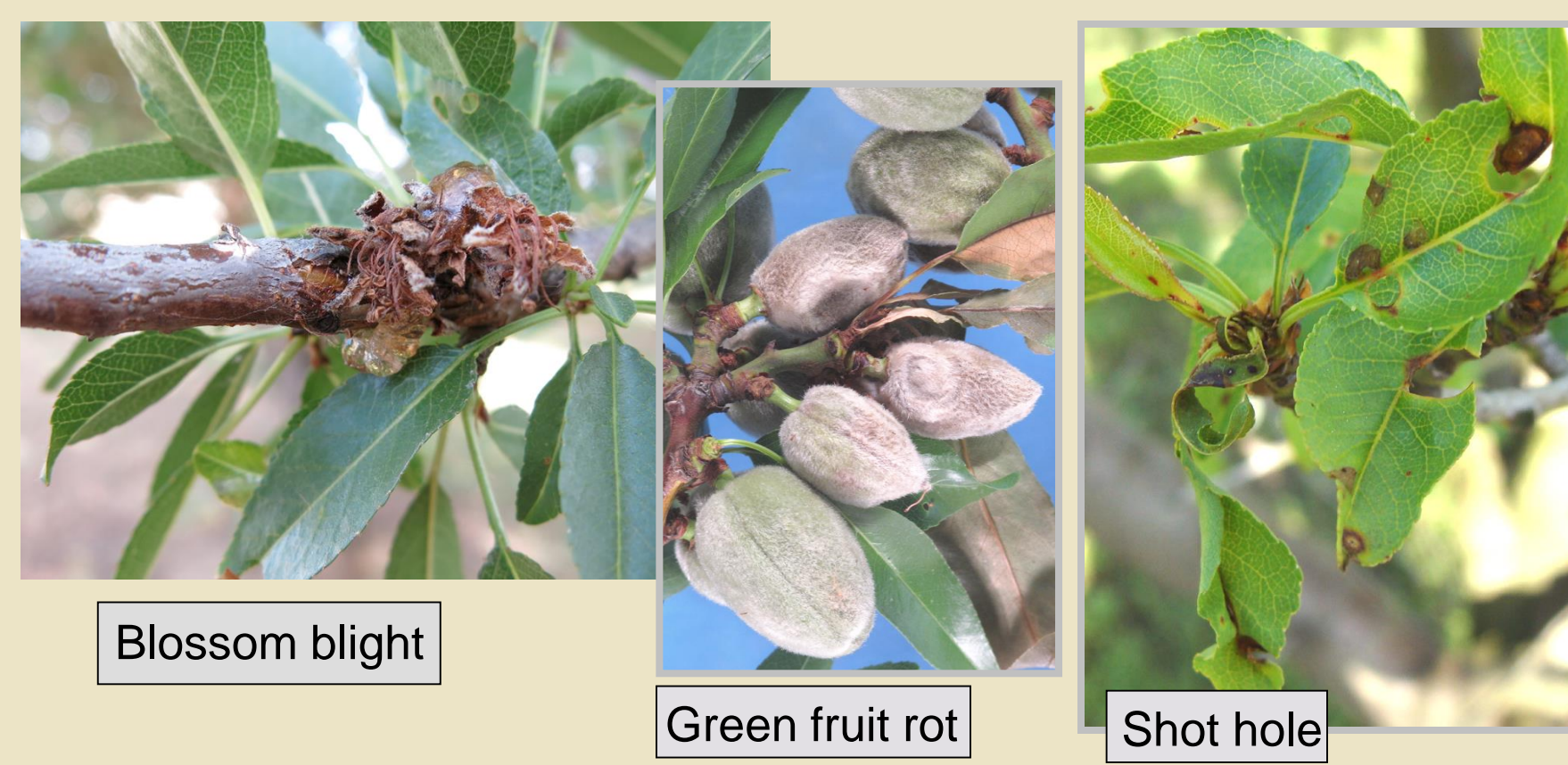


Epidemiology and Management of Brown Rot, Gray Mold, Shot Hole, Rust, and Hull Rot of Almond

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New fungicide developments and management strategies for almond

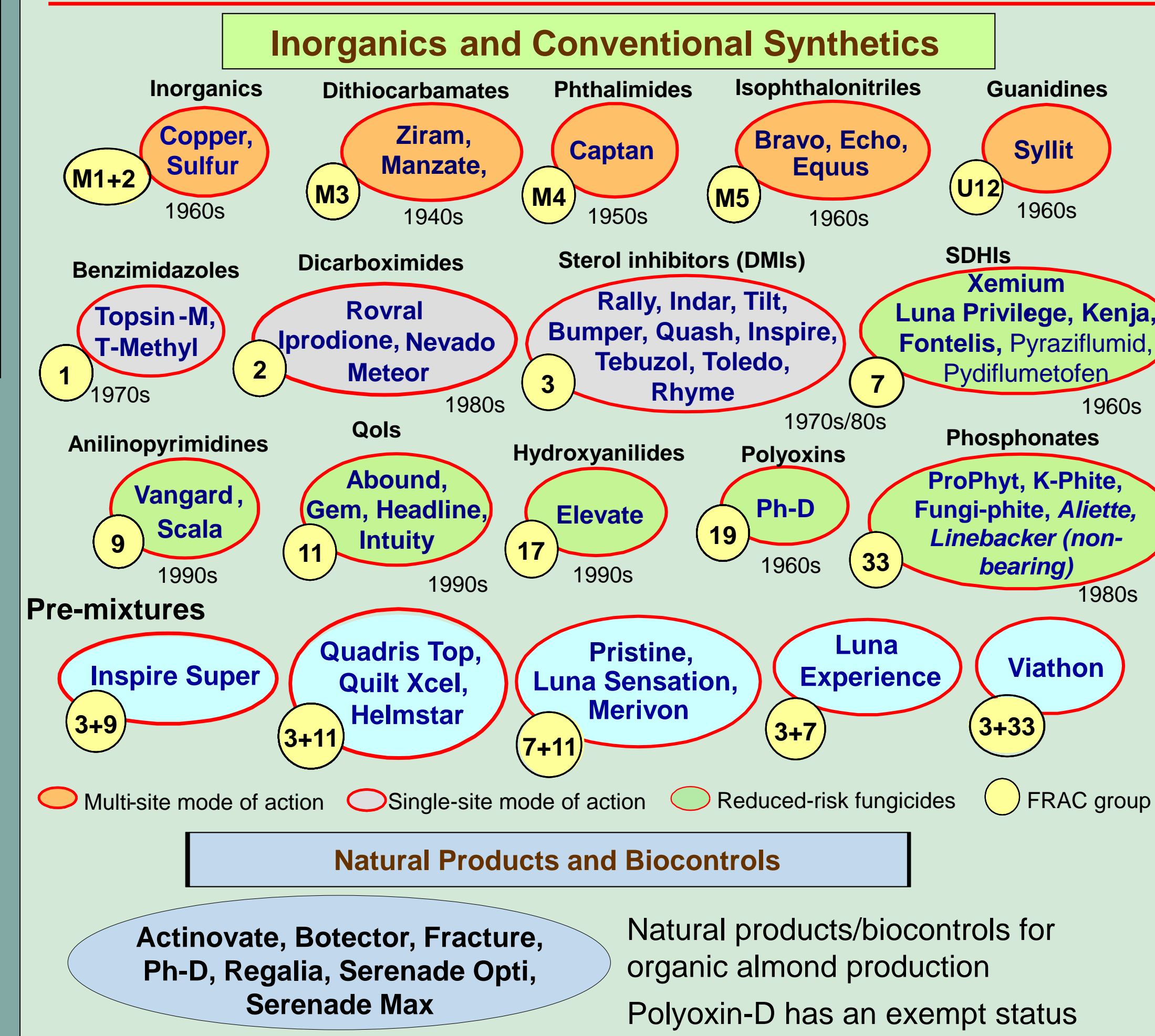
Soon to be registered: Helmstar
Recently registered: Rhyme (FG3), Kenja (FG 7), Merivon (FG 7/11), Syllit (U12), Viathon (FG 3+33), Manzate (M3), Toledo (FG 3)

Pending: Bravo – new PHI and rate; Aproach, Pyraziflumid, Pydiflumetofen, EXP-AD, -AF; UC-1, UC-2B; IL compounds

Integrated annual 6- to 7-spray management programs for the main flower, foliar, and fruit fungal diseases (brown rot, shot hole, jacket rot, scab, rust, Alternaria leaf spot, hull rot) and pests are being developed (see Almond Scab and Alternaria Leaf Spot poster)

No new fungicide resistance outbreaks!

Fungicides for Managing Almond Diseases



Hull Rot - Causal agents: *Rhizopus stolonifer*, *Monilinia fructicola* (*M. laxa*)



Hull rot caused by 1) *Rhizopus stolonifer* or 2) *Monilinia fructicola*. 3) Dieback associated with hull rot.

Inoculum of *Rhizopus stolonifer* is omnipresent (soil). Inoculum of *Monilinia fructicola* originates from almond and possibly other stone fruits (i.e., peaches, cherries). (Blossom blight can be caused by *M. laxa* and *M. fructicola*). The two hull rot pathogens require different management strategies and the severity of the disease is reported to be related to fumaric acid production by *R. stolonifer*. *Aspergillus niger* causes hull rot symptoms similar to those of *R. stolonifer*, but no dieback.

Field trials for management of hull rot (mainly caused by *R. stolonifer*) - cv. Nonpareil, Colusa Co.

Trials 1 and 2: Fungicides and alkaline foliar fertilizers

Treatment	Rate(/A)	5-31	7-13	Hull rot strikes/tree
Control	---	---	---	a
Ph-D	6.2	@	@	b
UC-1 + Sylcoat	4 + 8 fl oz	@	@	b
Pyraziflumid + NIS	5.08 + 8 fl oz	@	@	b
Ph-D + Tebucon	6.2 + 4 oz	@	@	b
Luna Experience + NIS	8 fl oz	@	@	b
UC-2 + Sylcoat	6 + 8 fl oz	@	@	b
IL-5412 + NIS	15 + 8 fl oz	@	@	b
IL-5413 + NIS	15.5 + 8 fl oz	@	@	b
IL-5414 + NIS	15.5 + 8 fl oz	@	@	b
Merivon + Sylcoat	6.5 + 6 fl oz	@	@	b
Fontelis + Tebucon + NIS	20 fl oz + 8 oz + 8 fl oz	@	---	b
Fontelis + Abound + NIS	20 + 15 + 8 fl oz	---	@	b
Fontelis + Tebucon + NIS	20 fl oz + 8 oz + 8 fl oz	@	---	b
Fontelis + Ph-D + NIS	20 fl oz + 15 oz + 8 fl oz	---	@	b
Quash	3.36 oz	@	---	b
Quash + Intuity	3.36 oz + 3.36 fl oz	---	@	b

5-31-17 application targeted against *Monilinia* pathogen
 7-13-17: advanced suture opening stage

Treatment	Rate(/A)	7-18	8-3	Hull rot strikes/tree
Control	---	---	---	a
di-K-PO4	48 oz	---	@	b
di-K-PO4	48 oz	@	@	b
di-K-PO4 + Ca(OH)2	48 + 320 oz	---	@	b
di-K-PO4 + Ca(OH)2	48 + 320 oz	@	@	b
Ca(OH)2	320 oz	---	@	b
Cinetis	24 fl oz	@	@	b
Cinetis	24 fl oz	---	@	b
Fontelis + Tebucon	20 fl oz + 8 oz	---	@	b
Fontelis + Inspire	20 + 7 fl oz	---	@	b
Fontelis + Abound	20 + 15.5 fl oz	---	@	b
Fontelis + Ph-D	20 fl oz + 6.2 oz	---	@	b

7-18-17: early suture opening, 8-3-17: 5% hull split. 0 4 8 12 16 20

Alkaline fertilizers were effective, possibly neutralize fumaric acid that is released by *R. stolonifer* into host tissues

Fungicides: All were similarly effective, reduction of disease up to 80%.

Brown Rot Blossom Blight and Shot Hole – Efficacy of new and registered fungicides 2017

cv. Drake, Applications on 2-16, 2-21-17

Treatment	Rate(/A)	PB	FB	Brown rot strikes/tree
Control	---	---	---	a
Rhyme	7 fl oz	@	@	bc
Inspire EC	7 fl oz	@	@	c
Pyraziflumid + NIS	3.38 + 4 fl oz	@	@	bc
UC-1 + Sylcoat	4 + 3.84 fl oz	@	@	bc
Pydiflumetofen	5.13 fl oz	@	@	bc
Luna Sensation + NIS	7.8 + 8 fl oz	@	@	c
Luna Experience + NIS	8 + 8 fl oz	@	@	c
Merivon	6.5 fl oz	@	@	c
Helmstar	14.5 fl oz	@	@	bc
UC-2 + Sylcoat	6 + 3.84 fl oz	@	@	c
EXP-AD	13.7 fl oz	@	@	c
IL-5412	15 fl oz	@	@	c
IL-5413	15.5 fl oz	@	@	b
IL-5414	15.5 fl oz	@	@	bc

NIS = non-ionic surfactant

cv. Sonora, Applications 2-16, 2-24, 3-15-17: biological and conventional

Treatment	Rate(/A)	PB	FB	PF	Brown rot strikes/tree	Shot hole lesions/fruit
Control	---	---	---	---	a	a
WXF-160001	0.35%	@	@	@	b	bcde
Botector	10 oz	@	@	@	cd	bcd
Fracture (old Form.)	32 fl oz	@	@	@	bc	bcde
MBI-110AF5	64 fl oz	@	@	@	cd	b
MBI-110AF5	128 fl oz	@	@	@	bc	bcde
MBI-110AF5 + Sugar	64 fl oz + 32 oz	@	@	@	bc	bc
MBI-10612	32 fl oz	@	@	@	cd	b
Indar 2F	6 fl oz	@	@	@	d	bcde
Fontelis	20 oz	@	@	@	cd	bcde
Indar 2F + Fontelis	6 fl oz + 14 fl oz	@	@	@	d	cde
Syllit + Tebucon	2 lb + 4 oz	@	@	@	cd	e
Quash + Intuity	2 oz + 2 fl oz	@	@	@	d	de
Luna Experience	8 fl oz	@	@	@	d	de

Best treatments

Brown rot

- Most effective single: Dicarboximides (FG 2), DMIs (FG 3), SDHIs (FG 7), APs (FG 9).
- New: Pydiflumetofen, Pyraziflumid, Helmstar, UC-1, UC-2, EXP-AD, IL compounds
- Pre-mixtures: FG 3+7, 3+9, 3+11, and 7+11.
- Pre-mixtures provide highest efficacy, consistency, and resistance management.
- Biologicals: Botector, Fracture, MBI compounds (intermediate efficacy)

Gray mold

- Most effective: SDHIs (FG 7) and APs (FG 9).
- New: Pydiflumetofen, a new effective botryticide.
- Effective pre-mixtures: FG 3+7, 3+9, 3+11, 7+11, and 3+33. Mixture: FG3+19. New: EXP-AF, UC-2B, IL compounds.

Shot hole

- Most effective: M3-M5, FG11. 19; pre-mixtures FG 3+7, 3+9, 3+11, 7+11, mixtures U12+FG 3, FG3+19.

Natural host susceptibility among cultivars and genotypes in the UCD variety block 2017

Trees were planted in 2014. Scions were grafted to Nemaguard and Krymsk rootstocks.

Some new cultivars such as Capitola and Jenette showed low susceptibility to brown rot and shot hole, similar to Nonpareil.

Genotype	Brown rot strikes/tree	Shot hole rating on leaves (0-4)
Wood Colony	a	c-i
p16.013	b	d-i
8-201 ucd	c	b-f
UCD 8-160	cd	d-i
Durango	cd	b-f
Winters	cd	ab
97-1-232	cd	a-d
1-271 ucd	cd	c-h
Y117-91-03	cd	c-g
7-159 ucd	cd	d-i
2-19e Total	cd	e-i
Supareil	cd	d-i
Sterling	cd	abc
Folsom-DW	cd	a
UCD 3-40	cd	a
UCD 116	cd	a-d
Aldrich	cd	ghi
y121-42-99	cd	b-e
Nonpareil	cd	hi
Capitola	cd	i
p13.013	d	d-i
UCD 8-27	d	a-e
Jenette	d	f-i

Overall summary of research

Hull can be effectively managed with fungicides and with alkaline foliar fertilizers integrated into management strategies:

- Different timing for the two pathogens:**
 - Rhizopus* hull rot: early hull split (with NOW application).
 - Monilinia* hull rot: late spring (late May / early to mid-June)
- Both pathogens are usually present at varying frequencies among locations and years, but *R. stolonifer* is more common.** Recommendations: 1-2 treatments - early/mid-June and at early hull split.
- Effective treatments:** Pre-mixtures or tank mixtures of FG 3+7, 3+9, 7+11, 3+11, and 3+19.
- Most effective integrated management of hull rot:** fungicides integrated with water management (i.e., deficit irrigation), restricted nitrogen fertilization (applied by early May or after harvest for Nonpareil), and dust reduction programs.