REPORT OT THE
ALMOND BOARD OF CALIFORNIA

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Project title: 1) Cause and control of Alternaria leaf spot, 2) bloom and foliage disease control, 3) wound treatments to control Ceratocystis canker, and 4) role of brown rot fungi in green fruit rot.

Cause and control of Alternaria leaf spot

During the last several years, Alternaria leaf spot has caused serious yield loss through severe and repeated defoliation of trees. Yield losses of 50% or more have been reported from some orchards. Early and multiple defoliation events each season weaken trees, reduce flowering, and affect fruit size. Although symptoms (leaf lesions) can be found in many orchards, especially late in summer, outbreaks sufficiently early and severe to cause debilitating defoliation occur most commonly in the southern San Joaquin Valley. *Alternaria alternata* is regularly cultured from leaf lesions and the pathogenicity of the fungus had been demonstrated.

Warm temperatures, dew, and humidity appear to play important roles in the development and severity of Alternaria leaf spot. The disease is consistently worse in areas of little or no air movement and where dews form and remain for many hours each day in late spring and summer. Altering cultural practices to reduce dew periods and lower relative humidity are an attractive possibility. In the past we attempted to accomplish this through weed control and heavy pruning, but neither method was successful. This year we used gypsum to increase water penetration and thereby reduce the duration of wet soil surface in hopes of reducing humidity and dew events.

Objectives

To compare the effects of two orchard management systems on:

1) environmental parameters including temperature, relative humidity, and leaf wetness

2) fungicide efficacy,

3) the incidence and severity of Alternaria leaf spot diseasesof almond trees,

4) development of populations of *A. alternata* on almond leaves

The orchard management treatments consisted of mid spring and early summer applications of 3 tons per acre of gypsum (6 tons per acre per year) or no gypsum. Temperature, relative humidity, and leaf wetness were recorded at 5 minute intervals daily from 11 April to 9 August using microloggers. Sensors were placed in the data row of each of two replications of the gypsum and no gypsum treatments. Relative humidity differed very little between the two treatments, the number of hours of leaf wetness varied, and temperature was similar in the two Fig. 1). These climatic factors were essentially the same as were the disease levels measured in the two treatments (Fig. 2). Although defoliation was slightly less in the gypsum treatment, gypsum treatment did not provide acceptable reduction in disease (Table 1).

The fungicide azoxystrobin (Abound), a Zeneca product, provided good control in efficacy tests conducted in 1997. Registration for this product is expected soon, thus it is an excellent candidate for fungicide control of Alternaria leaf spot. We tested several timing sequences using Abound in a split plot design with the gypsum and no-gypsum treatments as the main plots. There were six replications of the main plots and 12 of the Abound timing subplot treatments.

Three applications of Abound were better than two and applications made mid April through early June were better than those begun mid May and ending in mid June (Table 1). All fungicide timing treatments significantly reduced defoliation over that in the control. Fungicides in the efficacy test included azoxytrobin (Abound), trifloxystrobin (Flint), a Novartis product, tebuconazole (Elite) by Bayer, fenbuconazole (Indar) from Rohm and Haas), and wettable sulfur (Microthiol) provided by Elf Atochem. Of these, Abound was best and Flint and Elite next (Table 2). Both Flint and Elite reduced defoliation significantly compared to the control when evaluated in August but did not differ from the control just before harvest in September. Indar and sulfur at no time differed from the control.

The development of the pathogen population was monitored by washing 100 leaves collected from each non treated control tree at 2 to 4 week intervals beginning from 11 April to 9 August. Dilutions of the leaf wash water were cultured on agar petri plates and the number of colonies counted. From this count the number of conidia per leaf was calculated. Conidia were present in low numbers in mid April, increased slowly through the spring, the rapidly throughout summer (Fig 2). These same leaves were observed which were not present until mid May then increased rapidly though summer.

Butte trees grown at the Kearney Agricultural Center were used in field inoculations. Fifty leaves on shoots in each of six replications were inoculated with conidial suspensions of 10^6 conidia per ml and covered with plastic then paper bags for 72 hr. Inoculations were performed at approximately 3-week intervals from 22 April through 7 July. Leaves were observed for infection 10 to 14 days after inoculation. Inoculated leaves had significantly more leaf spot than non-inoculated leaves and percent infected leaves was very low until early July when increased was rapid (Fig 3). Severe mite infestation and defoliation of test trees interfered with our tests by mid July.

Similar inoculation experiments were conducted on detached shoots in the greenhouse. In these, some leaves were surface sterilized by a dip in 10% household bleach (to clean leaves of naturally occurring *A. alternata*) and others were not washed. Washed and unwashed leaves were inoculated or not inoculated, covered with plastic bags for 72 hours, then observed for lesions 4 to 7 days later. Although there were no significant differences among these treatments on each inoculation date (probably due to the low number (3) of replications), the increase in leaf susceptibility, measured by percent infected leaves, over the season was the same as found in natural infections and field inoculations (Fig. 4).

Bloom and foliage disease control

Various sequences of fungicides designed to control several diseases including brown rot, shot hole, scab, and leaf blight were compared. The sequences compared different choices of fungicide and numbers of applications. The intent was to determine how decisions made for controlling any given disease might affect control of other diseases. Most experiments also included efficacy tests of selected registered and experimental materials.

Objective

Compare various fungicide programs and test fungicide efficacy for control of spring diseases.

Experiments were located in Colusa, Madera, and Kern Counties. Materials were applied by hand-gun sprayers, and evaluations were made throughout the year for whichever diseases developed. Eight registered and 11 non registered fungicides were tested. Spring was very wet, with rains continuing into late spring. Brown rot, shot hole, scab, and leaf bight were present in one or more orchards in which we worked.

Generally, brown rot control was better where two applications were made during bloom compared to one full bloom treatment (Tables 3, 4, 5). Equivalent disease incidence occurred in both timings, pink bud and full bloom or pink bud and petal fall. Non registered materials shoed good efficacy for brown rot control.

Timing application according to the appearance of shot hole sporodochia in leaf lesions in spring tended to improve shot hole control though the differences between these treatments were not significant (Table 4). Using the shot hole sporodochia timing to determine the post bloom spray did not affect scab control. Scab control was more dependent upon fungicide choice than on treatment timing. Good scab control required two applications of materials effective against scab. Most non registered materials showed some efficacy against both diseases. Leaf blight results are unclear. Trees were evaluated using a rating system which did not adequately measure disease.

Role of brown rot fungi in green fruit rot.

Green fruit rot is caused by several fungi, *Monilina laxa* and *Botrytis cinerea* being the most common. The disease is prevalent in years of extended rains shortly after bloom and on cultivars the have clustered fruit. Infections are associated with fruit that touch or have adhering floral cups, petals, or leaves. The adhering tissues are thought to provide a food base for the pathogens and are required for infection to proceed.

Objectives

1. To confirm the relative importance of petals and floral cups as inoculum sources for green fruit rot.

2. To compare infection and rot of young green fruit by *M. laxa* and *B. cinerea* and confirm susceptible stages of fruit development.

3. To confirm relationship of wetness period duration on disease severity.

The importance of cast floral cups, petals and wetness duration in development of green fruit rot were investigated. Petals and floral cups that had been shed as young fruit enlarged were collected, air dried, and stored in the laboratory. These were dipped into or incubated for 24 hours in spore suspensions containing 10^5 conidia per ml of each pathogen immediately before placement on young green Carmel fruit and secured with a twistem tie. Controls included floral cups and petals incubated in water. All treatments were kept wet for 24, 48, or 72 hours by covering them with a plastic bag then paper bag. There were four replications of 20 to 25 fruit each arranged in a randomized complete block design. Fruit were observed for rot 7 and 10 days after inoculation.

Far more infection occurred when petals were used than floral cups (Table 6). Botrytis caused more rot than Monilinia in the first three inoculation dates but the reverse was true on the final date. The length of the wetness period was more important in early than in later inoculations. More rot occurred in the 48 and 72 hour wetness periods than in the 24 hour period. Fruit became more resistant to infection as they aged.

Wound treatments to control Ceratocystis canker.

We have been testing materials for use as wounds dressings to prevent infection by *Ceratocystis fimbriata*. Past experiments have shown that none of the fungicides registered for use on almonds, with the possible exception of benomyl (Benlate) can protect against this fungus. None are able to penetrate existing cankers when applied as topical treatments to stop infections. However, the combination of surgery and treatment, if performed in winter, does appear to aid in canker control.

Objectives

1. Test several wound dressing materials for prevention and control of Ceratocystis infections.

2. Determine the relationship of time between infection and treatment on control of current season infections.

3. Test effectiveness of surgery and time of surgery for control.

The efficacy of azoxystrobin (Abound), propiconazole (Break) and benomyl (Benlate) mixed with beeswax, beeswax alone, Benlate + summer oil, summer oil alone, two rates of Benlate, a mixture of lanolin, beeswax, vegetable oil, 2-3% neem oil and copper sulfate (BLNC), a mixture of propiconazole and imazalil (Nectec), a mixture of Kocide, hexol and boiled linseed oil ((Elixir) and Treeseal was tested. Bark pieces, 2.0 cm in diameter, were cut 30 June 1998 with a cork borer and removed so that the cambium was exposed. These wounds were immediately covered with the test materials then inoculated 1and 7 days later with 10^4 conidia per ml. Inoculated and non inoculated controls were included. All wounds were covered with tape for 3 days after inoculation. In addition, wounds similarly treated with Benlate in beeswax and Nectec were inoculated 30 days after treatment.

Final evaluation of these treatments will be made in late summer of 1999. In preliminary results, Nectec and Break in beeswax gave best control (Table 7). Beeswax alone and Benlate 10X + oil also were effective when inoculation occurred 7 days after treatment. Most materials were more effective, as judged by shorter cankers, when inoculated 7 days rather than 1 day after treatment.

An experiment to test the effect on efficacy of surgical removal and fungicide application at intervals after infection was established. Wounds were made in September 1998 and immediately inoculated. The resulting infections will be surgically removed and the clean wounds painted 7, 50 and 100 days later with Nectec, beeswax + benomyl, BLNC, and Elixir.

Table 1. Timing of azoxystrobin (Abound) treatments for control of Alternaria leaf spot of cv Butte almond trees, Kern County, 1998.

Bloom	15 April	1 May	15 May	1 June	15 June	Infected leaves (%)	Defoliation (%)	
	10 Apr	29 Apr	15 May	2 June	16 June	21 Aug	21 Aug	22 Sep
GRO	ABD		ABD			15.2 e	41.2 cd	70.3 bc
GRO		ABD		ABD		18.4 de	45.9 bc	77.2 b
GRO			ABD		ABD	23.3 bcd	48.1 b	75.6 b
GRO	ABD	ABD				20.7 cde	45.3 bc	78.4 b
GRO		ABD	ABD			20.2 cde	40.9 cd	70.9 bc
GRO			ABD	ABD		25.2 bc	47.5 b	76.5 b
GRO				ABD	ABD	27.1 b	46.2 bc	71.9 b
GRO	ABD	ABD	ABD			17.2 de	38.7 d	62.8 cd
GRO		ABD	ABD	ABD		23.0 bcd	37.2 d	57.2 d
			ABD	ABD	ABD	26.4 b	44.4 bc	72.5 b
GRO	NO TM	NO TM	NO TM	NO TM	NO TM	48.9 a	70.6 a	92.5 a
GYP							44.5	70.0
NO GYP							47.5	76.5
							NS	*

Code	Material	Rate a.f. per acre
ABD	Abound 25C	15.4 fl oz
GRO	Grower applied program	
GYP	Gypsum	6.0
NO GYP	No gypsum	0.0
NO TM	Non treated	

Application:	Hand-gun
Psi:	200
Gal/tree:	5
Tree spacing:	22 x 22
Tree/acre:	90

Rainfall (CIMIS Station #5, Shafter/USDA)

Date		Inches	Days
Apr	05-11	0.27	4
	12-18	0.07	2
	26-May 02	0.11	1
May	03-09	1.05	4
	10-16	0.33	2
	24-30	0.10	3
	31-Jun 06	0.07	1
Jun	07-13	0.60	1
Aug	30-Sep 05	0.12	1

Design:	Split plot
Main factors:	8 reps, 8-row plots
Gypsum	
No gypsum	
Subplots:	12 reps, single-tree plots
Fungicides	

Table 2. Fungicide efficacy for control of Alternaria leaf spot of cv Butte almond trees, Kern County, 1998.

Bloom	15 April	1 May	15 May	Infected leaves (%)	Defoliation (%)	
	10 April	29 April	15 June	21 Aug	21 Aug	22 Sep
GRO	ABD	ABD	ABD	11.7 b	32.5 d	61.2 c
GRO	FLN	FLN	FLN	17.0 b	41.2 c	81.2 b
GRO	ELT	ELT	ELT	39.2 ab	46.2 bc	83.7 ab
GRO	IND	IND	IND	51.7 a	57.7 a	95.0 a
GRO	SUL	SUL	SUL	54.5 a	51.2 ab	88.7 ab
GRO	NO TM	NO TM	NO TM	51.2 a	52.5 a	87.5 ab

Code	Material	Rate a.f. per acre
ABD	Abound 25C	15.4 fl oz
FLN	Flint 50WG	3.0 oz
ELT	Elite 45DF	5.0 oz
GRO	Grower program*	
IND	Indar 75WP	2.0 oz
NO TM	Non treated	
SUL	Microthiol	
I	Induce	8.0 fl oz/100 gal
L	Latron B1956	8.0 fl oz/100 gal

* Completed by 1 April

Application:	Hand-gun
Psi:	200
Gal/tree:	5
Tree spacing:	22 x 22
Tree/acre:	90

Design:	Randomized complete block
Replication:	4

Rainfall (CIMIS Station #5, Shafter/USDA)

Date		Inches	Days
Apr	05-11	0.27	4
	12-18	0.07	2
	26-May 02	0.11	1
May	03-09	1.05	4
	10-16	0.33	2
	24-30	0.10	3
	31-Jun 06	0.07	1
Jun	07-13	0.60	1
Aug	30-Sep 05	0.12	1

Table 3. Fungicide efficacy and timing for control of brown rot, shot hole and leaf blight diseases of cv Carmel almond trees, Colusa County, 1998.

25 % bloom	Late full bloom	Petal fall	Post bloom		Brown rot	Shot hole	Leaf blight
					Strikes/tree	Spots/fruit	Rating
25 Feb	5 Mar	19 Mar	1 Apr	22 Apr	28 Apr	12 May	3 Aug
BRK	BRK		ZIR	CAP	8.7 cd	6.0 c	5.6 abcd
ROV-16	ROV-16		ZIR	CAP	10.5 cd	9.8 c	4.6 bcd
BRK		BRK	ZIR	CAP	7.2 d	4.7 c	3.4 d
ROV-16		ROV-16	ZIR	CAP	11.3 cd	2.7 c	4.7 bcd
	BREAK		ZIR	CAP	14.3 cd	7.2 c	4.2 cd
	BRK + CAP		ZIR	CAP	11.2 cd	2.5 c	4.1 cd
	BRK + ZIR				18.3 cd	15.7 c	5.6 abcd
	ROV-16		ZIR	MAN	18.7 bcd	6.3 c	5.9 abc
AXG	AXG		AXG	AXG	40.0 ab	71.3 ab	3.3 d
AXG+ROV-8	AXG+ROV-8		AXG+ZIR	AXG+CAP	7.7 cd	5.0 c	5.5 abcd
QST + N	QST + N		QST + N	QST + N	26.2 bc	99.2 ab	6.4 ab
IND + 1	IND + L		IND + L	IND + L	6.0 d	31.3 b	6.7 a
NON TREAT					54.3 a	127.2 a	7.3 a

Code	Material	Rate a.f. per acre
AXG	AuxiGro	
BRK	Break 45WG	4.0 oz
CAP	Captan 50W	6.0 lb
IND	Indar 75WP	2.0 oz
MAN	Maneb	8.0 lb
QST	Quest	
ROV	Rovral 50W	1.0 lb
ROV-8	Rovral 50W	8.0 oz
TOP	Topsin 70W	1.5 lb
ZIR	Ziram 76W	8.0 lb
I	Induce	8.0 fl oz/100 gal
L	Latron B1956	8.0 fl oz/100 gal
N	Nu FIlm P	4.0 fl oz/100 gal

Application:	Hand gun
Psi:	300
Gal/tree:	2.0
Tree spacing:	12 x 18
Tree/acre:	202

Design:	Randomized complete block
Replication:	6

Rainfall (CIMIS Station #32, Colusa)

Date	Inches	Days
Feb 22-28	0.63	2
Mar 01-07	0.36	2
08-14	0.32	2
15-21	0.39	1
22-28	0.52	5
Mar 29-Apr 04	1.66	4
Apr 05-11	0.71	4
12-18	0.23	1
19-25	0.32	3
26-May 02	0.40	2

Table 4. Fungicide efficacy and timing for control of shot hole and scab diseases of cv Carmel almond trees, Madera County, 1998.

Pink bud	Full bloom	Petal fall	Post bloom		Shot hole Infected fruit (%)	Scab Infected leaves (%)
18 Feb	27 Feb	11 Mar	21 Mar*	16 Apr	18 June	21 July
ROV+O	ROV+O		ZIR		8.0 de	20.0 bcdef
ROV+O	ROV+O			ZIR	10.0 cde	27.5 bcd
ROV	ROV			ZIR	13.0 cde	31.5 bc
RAL-8+L	RAL-8+L		ZIR		15.0 bcde	19.0 bcdef
RAL-8+L	RAL-8+L			ZIR	28.0 abc	40.0 b
ROV+O		ABD			7.0 de	19.0 bcdef
ROV+O		BRV			14.0 bcde	9.0 defgh
ROV+O		ROV+O		ZIR	14.0 bcde	21.5 bcde
RAL-8+L		ABD	ZIR		2.0 e	12.0 cdefg
RAL-8+L		BRV	ZIR		5.0 de	1.5 gh
RAL-8+L		RAL-8+L		ZIR	13.0 cde	29.0 bc
ROV+O	BEN+CAP		ZIR		9.0 cde	4.5 fgh
ROV+O	TOP+ZIR		ZIR		10.0 cde	6.5 efgh
	RAL-8+L		ZIR		20.0 bcd	18.5 cdef
	ROV+O		ZIR		17.0 bcd	23.5 bcde
BRK	BRK			BRK	29.0 abc	16.5 cdef
FLN+VAN	FLN+VAN			FLN+VAN	28.0 abc	0.5 h
IND+L	IND+L			IND+L	38.0 ab	13.5 cdef
PRO-12	PRO-12			PRO-16	31.0 abc	31.0 bcd
NON TREATED					51.0 a	66.0 a

* Applied when sporodochia (shot hole) appeared.

Table 4 (cont)

Code	Material	Rate a.f. per acre
ABD	Abound 25C	15.4 fl oz
BRV	Bravo Ultrex	3.8 lb
BRK	Break 45WG	4.0 oz
CAP	Captan 50W	6.0 lb
FLN	Flint 50WG	3.0 oz
IND	Indar 75WP	2.0 oz
O	Omni Oil	1.0 %
PRO-12	Procure 50WS	12.0 oz
PRO-16	Procure 50WS	16.0 oz
RAL-8	Rally 40E	8.0 oz
ROV	Rovral 50W	1.0 lb
TOP	Topsin 70W	1.5 lb
VAN	Vangard 75WG	5.0 oz
ZIR	Ziram 76W	8.0 lb
L	Latron B1956	8.0 fl oz/100 gal

Application:	Hand-gun
Psi:	200
Gal/tree:	4 (pink bud) 5 (after pink bud)
Tree spacing:	24 x 24
Tree/acre:	76

Design:	Randomized complete block
Replication:	4

Rainfall (CIMIS Station #80, Fresno State)			
Date		Inches	Days
Feb	01-07	0.60	3
	08-14	1.10	4
	15-21	1.02	4
	22-28	0.30	2
Mar	01-07	0.48	2
	22-28	2.63	4
	29-Apr 04	0.80	3
Apr	05-11	0.29	3
	12-18	0.23	1
	19-25	0.06	1
	26-May 02	0.13	1
May	03-09	0.55	3
	10-16	0.25	2
	24-30	0.08	3
	31-Jun 06	1.24	1
Jun	07-13	0.17	1

Table 5. Fungicide efficacy and timing for control of brown rot and shot hole diseases of cv Ne Plus Ultra almond trees, Madera County, 1998.

Pink bud, 1% 4 Feb	Full bloom 13 Feb	Petal fall 25 Feb	Post bloom 2 Apr	Brown rot Strikes/tree 29 Apr	Shot hole Infected fruit (%) 12 May
ROV+O	ROV+O			2.2 e	1.0
ROV+O	ROV+O		ZIR	5.0 de	5.0
ROV	ROV		ZIR	9.7 de	8.0
RAL-8+L	RAL-8+L		ZIR	7.5 de	5.0
RAL-8+L	RAL-8+L			7.7 bcde	11.0
ROV+O		ROV+O	ZIR	3.7 de	2.0
ROV+O		ABD-15		5.0 de	5.0
ROV+O		BRV		12.0 bcd	13.0
RAL-8+L		RAL-8+L	ZIR	3.5 de	1.0
RAL-8+L		ABD-15	ZIR	17.5 bc	4.0
RAL-8+L		BRV	ZIR	19.5 b	5.0
ROV+O	BEN+CAP		ZIR	3.5 de	5.0
ROV+O	TOP+ZIR		ZIR	3.5 de	4.0
	RAL-8+L		ZIR	8.0 bcde	5.0
	ROV+O		ZIR	3.7 de	8.0
ABD-12	ABD-12		ABD-15	5.7 cde	2.0
BRK	BRK		BRK	4.5 de	10.0
FLN	FLN+VAN		FLN+VAN	4.2 de	3.0
ELT+I	ELT+I		ELT+I	2.0 e	1.0
ELT+ROV-8	ELT+ROV-8		ELT+ROV-8	2.0 e	3.0
IND+L	IND+L		IND+L	4.5 de	10.0
PRO-12	PRO-12		PRO-16	3.5 de	4.0
QST+N	QST+N		QST2	8.7 cde	10.0
RAL-6+L	RAL-6+L		RAL-6+L	8.2 bcde	5.0
NON TREATED				42.7 a	20.0
					NS

Code	Material	Rate a.f. per acre
ABD	Abound 25C	15.4 fl oz
BEN	Benlate SP	1.5 lb
BRK	Break 45 WG	4.0 oz
CAP	Captan 50W	6.0 lb
FLN	Flint 50 WG	3.0 oz
IND	Indar 75WP	2.0 oz
O	Omni Oil	1.0 %
PRO-12	Procure 50WS	12.0 oz
PRO-16	Procure 50WS	16.0 oz
QST	QST 713WP	31.7 lb
QST2	QST 713WP	31.7 lb
RAL-8	Rally 40E	8.0 oz
ROV	Rovral 50W	1.0 lb
TOP	Topsin 70W	1.5 lb
VAN	Vangard 75WG	5.0 oz
ZIR	Ziram 76W	8.0 lb
L	Latron B1956	8.0 fl oz/100gal
N	NuFilmP	4.0 fl oz/100gal

Application:	Hand-gun
Psi:	200
Gal/tree:	4 (pink bud)
	5 (after pink bud)
Tree spacing:	24 x 24
Tree/acre:	76

Design:	Randomized complete block
Replication:	4

Rainfall (CIMIS Station #80, Fresno State)

Date		Inches	Days
Feb	01-07	0.60	3
	08-14	1.10	4
	15-21	1.02	4
	22-28	0.30	2
Mar	01-07	0.48	2
	22-28	2.63	4
	29-Apr 04	0.80	3
Apr	05-11	0.29	3
	12-18	0.23	1
	19-25	0.06	1

Table 6. Effect of wetness period on infection of young green cv Carmel almond fruit inoculated with *Monilina laxa* and *Botrytis cinerea*, Fresno County, 1998.

	Infected fruit (%)[x]					
	Petal inoculant					Floral cup inoculant
	Dipped in pathogen				Incubated	
	26 Mar	1 Apr	3 Apr	7 Apr	1 Apr	25 Mar
Fruit length, mm	19.5	20.4	24.7	28.9	20.4	19.3
Pathogen						
Botrytis	60.8 a[y]	55.4 a	40.5 a	12.3 b	----	14.7 a
Monilinia	27.2 b	14.6 b	23.1 b	25.0 a	16.6	8.5 b
Water	5.2 c	1.6 c	3.8 c	3.2 c	4.9	3.5 c
Wetness period[z]						
24h	18.9 c	18.1 b	16.1 b	8.8 b	9.5	4.0 b
48h	31.3 b	23.5 ab	21.7 a	13.8 a	11.3	10.6 a
72h	42.9 a	30.0 a	29.5 a	17.9 a	11.4	12.2 a
Significance of *F*, *P* =						
Pathogen	0.000	0.000	0.000	0.000	0.0002	0.000
Wetness	0.000	0.050	0.001	0.047	NS	0.008

x Petals or hypanthia (floral cups) were dipped in water immediately before use or incubated for 24 hours in water suspensions containing 10^5 *M. laxa* or *B. cinerea* conidia/ml or in water prior to placement on green fruit. Twenty to 25 fruit per replication.

y Four replications of each treatment in a randomized complete block design. Means followed by the same letter do not differ significantly according to Duncan's multiple range test.

z Inoculated fruit kept wet after inoculation by covering them with plastic bags then paper bags.

Table 7. Effect of time between treatment and inoculation on efficacy of wound treatment to prevent infection of cv. Nonpareil almond trees inoculated with *Ceratocystis fimbriata*, Fresno County, 1998.

Material	Canker length, cm[y] Days after treatment when inoculated[z]			
	1	7	30	Non inoculated
Abound in beeswax	4.50	0.95		0.0
Benlate in beeswax	1.15	1.45	4.3	----
Break in beeswax	0.58	0.50		0.0
Beeswax	2.88	0.0		0.0
BLNC	2.6	1.15		0.0
Nectec	0.0	0.92	0.0	0.0
Benlate + oil	6.05	2.50	----	0.0
Benlate 10X + oil	2.70	0.78		0.0
Oil	13.52	8.22		0.0
Elixir	5.1	3.75		0.0
Treeseal	10.75	8.50		0.0
Inoculated control	17.65	13.8		0.0
Non inoculated control	0.0	same	same	same

y Measured 21 September 1998.

z Wounds made and treated 30 June, inoculated 1, 8, 31 July 1998