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Commodity Group: Almond Board
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Project No.90-T15: Forecasting almond shot hole disease and controlling shot hole, brown rot, leaf rust, green fruit rot, and scab under sustainable practices.

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Key words: Wilsonomyces, Monilinia, Botrytis, Tranzschelia, Cladosporium, fungicides

SUMMARY:

A three-year, field study was concluded on the effectiveness of a forecasting system for shot hole disease. The study determine ways of reducing fungicide sprays based on the amount of inoculum and weather conditions during the spring. Research included experiments to prevent increases in inoculum (spores of the shot hole fungus, Wilsonomyces carpophilus Adaskaveg, Ogawa, and Butler), to develop and verify monitoring practices for shot hole, and to control the disease based on a minimum number of timed sprays based on disease forecasting. In fall (1990), spring (1991), and fall (1991), the natural development of disease and development of inoculum were monitored in four test plots representing northern (Butte County/J. Connell), central (Merced County/L. Hendricks, Solano County/UCD personal), and southern (Kern County/M. Viveros) portions of the central valley where almonds are grown. The parameters of the program were: **(A)** To monitor disease levels in the fall season to determine the incidence of sporodochia (inoculum) of the fungus (and if warm weather and rains are forecasted, defoliation of trees with zinc sulfate sprays is suggested to prevent increases in inoculum formation); **(B)** To identify the risk level (high or low) in orchards based on the levels of inoculum found in fall; **(C)** To monitor weather forecasts, disease, and inoculum levels in the spring; and **(D)** To apply fungicides in the spring based on items A, B, and C. Two disease scenarios have been identified: **High Risk** - high inoculum levels in the fall and fungicide application as soon as leaves emerge; and **Low Risk** - low inoculum levels in the fall and delayed fungicide application based on the development of secondary inoculum in the spring. Disease progression and levels of control for various spray programs are presented for all test plots. Results indicate that shot hole of almond can be effectively controlled using monitoring, forecasting, and a reduced spray program.

Additionally, a new fungicide CGA 173506 was evaluated and its efficacy was similar to current standard treatments (iprodione, ziram) for the control of shot hole. In both currently accepted and reduced spray programs, the incidence and severity of scab and rust also were monitored and evaluated in the fall (1991). Control of scab was significantly better

in the reduced spray program that included a 5-wk-after petal fall application of ziram than the currently accepted program; while neither program effectively controlled rust.

INTRODUCTION:

In California, shot hole disease caused by Wilsonomyces carpophilus is widely distributed and is one of the major diseases of almond trees (Adaskaveg, Ogawa, and Butler, 1990). The disease primarily occurs on leaves and fruit of almonds and under severe infection can cause defoliation of the tree (Ogawa and English 1991), as well as decrease yield (Highberg and Ogawa 1986). If defoliation occurs in the spring and early summer, trees may be stressed resulting in a decrease in crop yield; while if fruit drop occurs, a direct loss of the crop results. In the spring, rains can be common and with new, susceptible leaves present control practices are essential in preventing disease and potentially crop loss. Control practices have been focused solely on the use of fungicides to protect newly emerged leaves at or shortly after spring bloom. Several fungicides are currently registered for shot hole control including captan, ziram, iprodione, and copper; while captan and ziram are the most effective of these material. Thus, spray applications have been based on stages of growth (pink bud, full bloom, petal fall, etc.) and weather forecasts. Under this program, usually 3-5 sprays are applied until the '5-wk after petal fall' deadline set each year by the Agricultural Commissioner of a county.

Currently, the public, legislators, growers, and the agricultural industry are concerned about the widespread use of pesticides in our agricultural system. Concerns about the quality of our food supply, effects on our health, and protecting our environment have propelled the agricultural community to reduced pesticide usage and investigate alternative practices for the control of pests of agricultural crops. In the control of almond diseases and more specifically shot hole of almond, our research has focused evaluating new materials that may potentially be safer to humans and the environment and to develop a reduced spray program using currently available materials that control more than one disease.

In order to develop an effective, reduced spray program for the control of shot hole and other diseases of almond, the whole biology of the pathogen, the epidemiology of the disease, and seasonal weather patterns in California have to be understood. Based on our research, disease can develop whenever susceptible almond leaves (or fruit), the fungus, and a conducive environment are coincident (Adaskaveg, Shaw, and Ogawa 1990; Shaw, Adaskaveg, and Ogawa 1990). In California, cool to warm temperatures (15-25 C), rains, and susceptible host tissue occur more commonly in the spring and fall. Additionally, formation of new inoculum is critical for initiating epidemics. Realizing these factors and that conidia (spores or propagules) of the fungus can not survive in orchards indefinitely (Ogawa - Annual Report 1990), an effective reduced spray program is dependent on monitoring disease and inoculum development in orchards. Thus, disease and inoculum formed in the fall and spring are critical in determining disease incidence and control practices (Ogawa and Adaskaveg 1991).

In the last three years, we have evaluated a disease monitoring-reduced spray program for the control of shot hole disease (Ogawa and Adaskaveg 1991). In this program, disease levels are monitored in the fall. In the last week of October, defoliation of trees with zinc sulfate is suggested if conducive temperatures and rainfall are forecasted. Leaf removal will prevent the formation of new inoculum since the fungus only rarely causes perennial infections in twigs of almonds. Regardless of whether defoliation sprays are applied, risk levels are established for monitored orchards. In high risk orchards, inoculum levels in the fall are high and timing of fungicidal sprays in the spring begin as soon as leaves emerge. In low risk orchards, inoculum levels in the fall are low and timing of fungicidal sprays in the spring are based on wetness periods, disease incidence, and inoculum levels (as indicated by the formation of sporodochia) (Ogawa and Adaskaveg 1991).

OBJECTIVES:

(1) Shot hole:

A. Evaluate new fungicides for the control of shot hole.

B. Develop and verify a minimal but effective protective spray program for shot hole through forecasting and disease monitoring procedures.

(2) Scab and Rust:

Determine the incidence of scab and rust in test orchards and to determine the effectiveness of a reduced spray program in controlling these diseases.

MATERIALS AND METHODS:

Evaluation of new fungicides for shot hole control. A field plot was established in an experimental orchard at the Armstrong research station on the campus of the University of California, Davis. Treatments were of a randomized design. Treatments, chemical formulations, rates of application, blossom stage, and date of application of in the spring of 1991 are shown in Table 1. In the beginning of April, 200 leaves (50/quadrant) were collected from each treated tree and evaluated for the average number of sporodochia, percent infection, and disease severity (disease index). Average number of sporodochia was calculated based on the total number of leaves collected; percent disease was calculated as the percentage of leaves with 1 or more shot hole lesions divided by the total leaves sampled per tree; while disease index was determined by placing leaves into categories based on the number of lesions/leaf, multiplying the number of leaves in each category by the categories mean number of lesions, and the summation of these values is divided by the total number of leaves sampled. All treatments had six single tree replications.

Development and verification of a forecasting system and reduced spray program for shot hole of almond. Field trials were established in an experimental orchard in Solano County (UC Davis) and in commercial orchards in cooperation with Farm Advisors in Kern County (M. Viveros), Merced County (L. Hendricks), and Butte County (J. Connell). In each orchard treatments were of a randomized design. Ziram treatments were applied (8 lbs/A) to trees based on different stages of bloom (traditional recommendations) or were based on the forecast-monitoring system (timing treatments). In the Butte and Solano plots, timing treatments either received no pink bud spray (Timing 1) or received a pink bud spray (Timing 2) with subsequent applications of ziram based on the production of sporodochia on leaves. All treatments had six single tree replications and were surrounded by trees of similar treatment (buffer trees) to prevent spray contamination from adjacent treatments. All spray treatments in commercial orchards were applied using an air blast sprayer; while trees in the experimental orchard were sprayed with a hand sprayer.

In the fall 1990, defoliation treatments were not applied and disease was allowed to develop at each test site. In the last weeks of November 1990, disease and sporodochia production were evaluated from leaf samples collected from each plot. For this 200 leaves (50/quadrant) were sampled from control trees. Plots were assessed as either high or low risk based on the presence or absence of sporodochia of the fungus, respectively.

In the spring of 1991, 200 leaves (50/quadrant) were sampled from non-treated control trees in each plot in approximately 10-day intervals from leaf emergence (late February) through 5-wks after petal fall (mid-April) and evaluated for disease and production of sporodochia of the fungus. Four to six samplings were made in each plot and dates of leaf evaluations are indicated in control treatments for each plot figure. Microclimate parameters (temperature, leaf wetness, etc.) were in two orchards (Merced and Solano plots) using dataloggers; while environmental parameters (temperature and rainfall) for all plots were obtained from CIMIS stations near test plots or from growers weather monitoring equipment (Kern County). Percent disease and average number of sporodochia were calculated as previously described. All treatments had six single tree replications. Leaves and fruit (100/replicate) also were evaluated in each plot in mid-May (1991); in the Solano plot, percent infection and disease severity of leaves (200 leaves/tree) were also evaluated in September. Data were analyzed using ANOVA and means followed by the same letter were not significantly different ($\underline{P} > 0.05$).

Disease identification was done by observation of sporodochia of W. carpophilus or by isolation of the fungus. For the latter, 10 to 20 lesions per sampling were cut from disease leaves, surface sterilized (4 ppm/1 min.), plated on potato dextrose agar, and incubated at 25 C. Isolation of the fungus was recorded as percent recovery (no. of positive isolations/total number of lesions plated).

Additionally, in the Merced orchard, the plot was divided into: a ziram treatment at 5-wks after petal fall and no ziram treatment 5 wks after petal fall. The site was then designed and evaluated as a split plot. In the Solano plot, leaf drop was evaluated in addition to disease data. For this, standardized boxes were placed in the same direction and distance from the tree trunk under each replicate tree for each treatment. Leaves were collected and counted from each box every seven days for a 5-wk period. Percentage of fallen leaves with shot hole and average leaf drop with shot hole were compared for each treatment. Data were analyzed using ANOVA and means followed by the same letter were not significantly different ($\underline{P} > 0.05$).

Evaluation of Scab and Rust. In September 1991, leaf samples (200/tree) were collected in the Merced plot from each replicate of all treatments established in the spring. Percent infection was determined for each treatment as described previously. Data were analyzed using ANOVA and means followed by the same letter were not significantly different ($P > 0.05$).

In the test plots in Butte, Solano, and Kern county, scab and rust were not observed. Adjacent to our test plot in Butte County, however, scab infected leaves were collected and evaluated from infected trees.

RESULTS AND DISCUSSION:

Shot Hole Control with the Experimental Fungicide CGA 173506. In a field plot established in an experimental orchard (cv. Drake) at the Armstrong research station on the UCD campus, three concentrations of the new experimental fungicide CGA 173506 (75WG) was compared to treatments of triforine/ziram (Funginex 1.6EC/Ziram 76WP), iprodione (Rovral 50WP), and zinc-dimethyldithiocarbamate (Ziram 76WP) (Table 1). Shot hole control was significantly less in the ziram, CGA (all rates), and iprodione treatments than in the triforine treatment; all treatments were significantly better than the non-treated control trees (Fig. 1). For disease index values, divide the y-values by 10.

Shot Hole Control Using Monitoring, Forecasting, and a Reduced Spray Program. In the fall 1990, cool weather, lack of rainfall, and early dehiscence of leaves resulted in low disease levels in most plots. Sporodochia were not observed in plots in commercial orchards, while sporodochia were observed in the Solano plot. Thus, the commercial plots had low inoculum levels (no sporodochia were observed) and were considered a low risk; while the Solano plot had high inoculum levels (29% of the sampled leaves had sporodochia) and was considered a high risk for disease in the spring of 1991.

In the spring of 1991, rain accumulations were high when compared to previous years of the monitoring, forecasting, and reduced spray program. Rain accumulations for test sites from late February-March 1991 were: Butte-10.6"; Kern-4.7"; Merced-6.2"; and Solano-8.4". Daily minimum-maximum temperatures and rainfall monitored in or near test plots throughout the spring are shown for each plot (Figs. 2, 6, 8, 10).

Based on periodic sampling of almond leaves from non-treated trees (controls), development of sporodochia of the fungus was monitored throughout the spring (Figs. 2, 6, 8, 10). Two scenarios for disease development were observed. In plots with low inoculum observed in the fall (low risk), incidence of disease (percent infection) in the spring remained < 10% until new sporodochia were produced (Figs. 2, 6, 8). Once sporodochia were observed in the spring, the disease incidence increased to 22%, 19%, and 38% in the Merced, Kern, and Butte plots, respectively. In the Solano plot, where high inoculum was found in the fall (high risk), incidence of disease was high (> 38%) from the onset of leaf emergence (Fig. 10).

In an evaluation of spray programs, timing and number of spray applications of ziram were compared. By May, in both the Merced and Solano county plots, no differences were observed in percent disease between the recommended or grower treatments (3 applications) and the timing treatments (2 applications) (Figs. 3, 11). Disease incidence (percent infection) in the ziram spray treatments was < 10% in the Merced plot and < 15% in the Solano plot; while disease incidence in the non-treated trees (controls) was > 20% (Merced plot) and > 40% (Solano plot). In both plots, Wilsonomyces carpophilus was isolated from lesions on leaves with percent recovery > 85%. Similarly, by mid-April in the Butte county plot, no difference was observed between the recommended, timing-1 (no pink bud application of ziram), and timing-2 (pink bud application of ziram) treatments; , however, these treatments were different than the control treatment (Fig. 7).

By May, however, in plots in both Butte and Kern county, no differences were observed between the recommended, timing, and control treatments (Figs. 7, 9). In both of these plots, sporodochia were observed in early to mid-March. In the Butte plot, the fungus was isolated from infected lesions (> 60%) but the incidence of disease was high (20-25%) for all spray programs. In the Kern plot, however, symptoms occurring in May were questionable and the fungus was isolated with only 11% recovery from the atypical lesions. Other fungi isolated included Alternaria and Epicoccum species. Possibly, the atypical symptoms that were similar to shot hole were caused by other factors (e.g. herbicide damage).

In the Solano plot, when leaves were evaluated on 3/9 and 3/26, only the recommended treatment controlled the disease (Fig. 11). This field was rated as a high risk (based on the presence of inoculum during the previous fall). Effects on crop yield were not measured in the current study. Defoliation caused by shot hole, however, was recorded and indicated significant differences between treatments in number of fallen leaves with shot hole and in the average leaf drop of diseased leaves for 4/1, 4/8, and 4/19 evaluations. Differences were observed between the recommended, timing, and non-treated treatments (Figs. 12, 13). Thus, in the high risk orchard, a spray program that protects the leaves at emergence gave the best results in controlling shot hole and preventing drop of disease leaves.

In the Merced plot, results of the effect of a ziram application at 5-wk after petal fall indicated that by one month after treatment (evaluated in May) no significant differences were observed in disease incidence (15% no ziram; 11% ziram) or disease severity (19% no ziram; 12% ziram) of leaves. Number of sporodochia were significantly greater in treatments with no ziram at 5 wk after petal fall (4.5%) than in treatments with ziram (0.3%). No significant differences were observed in disease incidence, severity, or incidence of sporodochia between the recommended and timing treatments; while both of these treatments were significantly less than the controls in the measured parameters (Fig. 4). In fruit evaluations, disease incidence was significantly lower in the treatments with ziram (23%) than the treatments without ziram (10%); however, when disease severity was evaluated, no difference was observed between treatments (no ziram/1.68 DI; ziram/0.79 DI). As in the leaf evaluations, recommended and timing treatments were significantly less than the controls but not significantly different from each other (Fig. 5).

Incidence and severity of shot hole of fruit was recorded and shown for each plot (Figs. 14, 15). In all plots except the Solano plot, no differences were observed in either incidence or severity of disease between the recommended and timing treatments (Figs. 14, 15). In the Solano plot, where high inoculum was recorded in the fall (high risk rating), the timing treatment that received a pink bud spray had a higher incidence of disease (Fig. 14), while the timing treatment that did not receive a pink bud spray had a greater severity of disease (Fig. 15) than the recommended treatment. Yield data was not recorded.

Control of Scab, Rust, and Shot Hole in Late Summer-Early Fall. In the summer and fall of 1991, scab caused by Cladosporium carpophilum, rust caused by Tranzschelia discolor, and shot hole were evaluated in the shot hole test plots located in Butte, Merced, and Solano counties. Scab and rust developed only in the Merced plot. In the overall analyses, scab was significantly reduced in the timing treatment from that of the recommended and control treatments; while no treatment controlled rust (Fig. 16). In the split plot test, results for scab and rust control were similar to the overall analyses (Fig. 17); however, for scab control, disease was significantly higher in treatments not sprayed with ziram at 5-wk-after petal fall (Fig. 17). In the commercial orchards in Butte and Merced Counties, portions of the orchard adjacent to our plots were defoliated from scab infections by late summer. Trees with the highest incidence of disease were not treated with ziram at 5 wks after petal fall.

In all test plots, shot hole was significantly lower in both the recommended (current bloom and petal fall sprays) and in the timing treatments (based on monitoring and forecasting) than in the non-treated control trees. In the Merced plot, disease was high in all treatments, although the recommended treatment was significantly better than the timing treatment in percent infection (Figs. 16, 17) and disease severity (Fig. 18). In the Solano plot, recommended and timing treatments were not significantly different from each other in either percent infection or disease severity (Fig. 19). A possible explanation is that in the Merced plot, high-angle sprinklers supplied water into the canopy of the tree. Since one less ziram spray was applied in the timing treatment, the additional water removed more fungicide from tree leaves resulting in higher disease levels and less control in the timing treatments.

DISEASE DEVELOPMENT SUMMARY:

On almond, shot hole disease causes seasonal infections of leaves, fruit, and occasionally blossoms. Since perennial infections of twigs do not occur (or are extremely rare), the disease has to be initiated each year from overwintering spores. Studies on spore survival indicate that spores can survive several months in an orchard during unfavorable environmental conditions for infection (Annual Report - 1990; Ogawa and Adaskaveg 1991). Spores from fall infections serve as the primary inoculum. In the spring, our current understanding indicates that the primary inoculum has to be redistributed (e.g. by rain) to susceptible tissue. Provided that favorable wetness periods and temperatures occur when susceptible leaves are present, the initial amount of disease is dependent upon the initial inoculum (spores) level of the fungus as measured by the amount of sporodochia occurring in the fall. Increase in disease after initial infection is dependent on the formation of new inoculum (sporodochia) and continued favorable environments.

BENEFITS OF A FORECASTING PROGRAM:

Benefits of a forecasting program would forewarn growers of high risk orchards based on the amount of inoculum formed during the previous fall season. Thus, timing of sprays during the following spring would be based on the disease incidence during the previous fall season. If disease was limited in the fall (low risk), based on disease monitoring techniques, spray treatments in the spring may not be required until after the first infection and sporodochial development period. The newly formed spores are considered secondary inoculum and are formed directly on susceptible tissue. At this time, preventative spray treatments are most effective in preventing disease. Thus, spray treatments (e.g. ziram or captan) could be delayed until after the petal fall stage of bloom. At this time, spray treatments would benefit in controlling shot hole, scab, and possibly leaf blight.

When severe outbreaks of shot hole occur in the fall (high risk) control practices would begin as soon as leaves emerge in the spring. Additional spray treatments could be governed by wetness periods and disease outbreaks for individual orchards being monitored. In both disease scenarios (low or high risk), a spray application of ziram at 5-wk after petal fall reduces the incidence of shot hole on fruit and provides some protection of leaves from scab latter in the season.

Based on our results, the forecasting system can reduce the use of fungicides (ziram) by reducing the number of spray applications. From 1989 to 1991, extremes in precipitation, the amount of disease observed, and in the number of spray applications applied occurred in the four test plots established throughout the central valleys. In some years, depending on the amount of inoculum in the fall and the weather conditions in the spring for each plot, the number of fungicide (e.g. ziram) applications were the same or similar to applications based on the spray program using stages of tree growth ("recommended treatment" in our studies) to determine time of application. In other years, however, weather conditions were unfavorable for disease development resulting in low disease and inoculum levels. Under these conditions, results (Annual Reports 1989-1991) have indicated that no sprays were required for the control of shot hole during the spring. Thus, our forecasting system is a flexible program that utilizes seasonal monitoring procedures of disease, inoculum, and environmental parameters in an almond orchard to determine spray applications.

PUBLICATIONS:

1. Adaskaveg, J.E., Ogawa, J.M., and Butler, E.E. 1990. Morphology and ontogeny of conidia in Wilsonomyces carpophilus, gen. nov. comb. nov., causal pathogen of shot hole disease in Prunus species. Mycotaxon 37: 275-290.

2. Adaskaveg, J.E., Shaw, D.A., and Ogawa, J.M. 1990. A moisture generator and environmental monitoring system for field studies on shot hole disease of almond. Plant Disease 74: 558-562.

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4. Ogawa, J.M. and J.E. Adaskaveg. 1991. Concepts and potential practices in forecasting and controlling shot hole of almond in California. Phytopathology 81: 1137.

5. Ogawa, J.M. and H. English. 1991. Diseases of Temperate Zone Tree Fruit and Nut Crops. University of California, Division of Agriculture and Natural Resources, Oakland, CA. Publication 3345. 461 pp.

6. Shaw, D.A., Adaskaveg, J.E., and Ogawa, J.M. 1990. Influence of moisture and temperature on infection and development of shot hole disease of almond caused by Wilsonomyces carpophilus. Phytopathology 80: 749-756.

Table 1. Fungicides, Rates, Time of Application, Flowering Stage, Preharvest Sprays, and Harvest Dates
Armstrong Plot - Spring '91

			Dates/Flower Stage			
			'2/19	'2/20	'3/5	'3/14
Crop	Fungicides	Rates a.i./A	P	P	PF	1-wk after PF
Almond	CGA-L	1.5 oz.	@	'—	@	@
	CGA-M	3.0 oz.	@	'—	@	@
	CGA-H	4.5 oz.	@	'—	@	@
	Fung./Zir.	7.2 oz.	F	'—	F	FZ
		6 lb.	'—	'—	'—	'—
	Rovral	8 oz.	@	'—	@	@
	Ziram	8 lb.	'—	@	@	'—
	Check					

Note: Almond Flower Stages
P - Pink
PF - Petal Fall
Fungicides used:
Rovral = Rovral 50WP   Zir. = Ziram 76 WP
Fung. = Funginex 1.6EC   CGA = CGA 173506 75WG

Figure 1.
EFFICACY OF FUNGICIDES FOR CONTROL OF SHOTHOLE ON ALMOND LEAVES

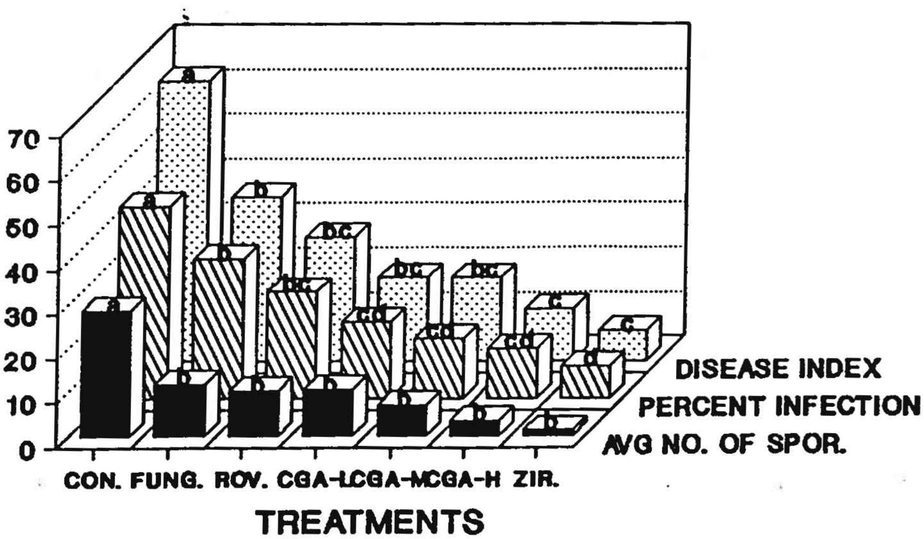


Figure 2.
Temperature, Rainfall, and Incidence of Shothole - Merced County/Spring 1991

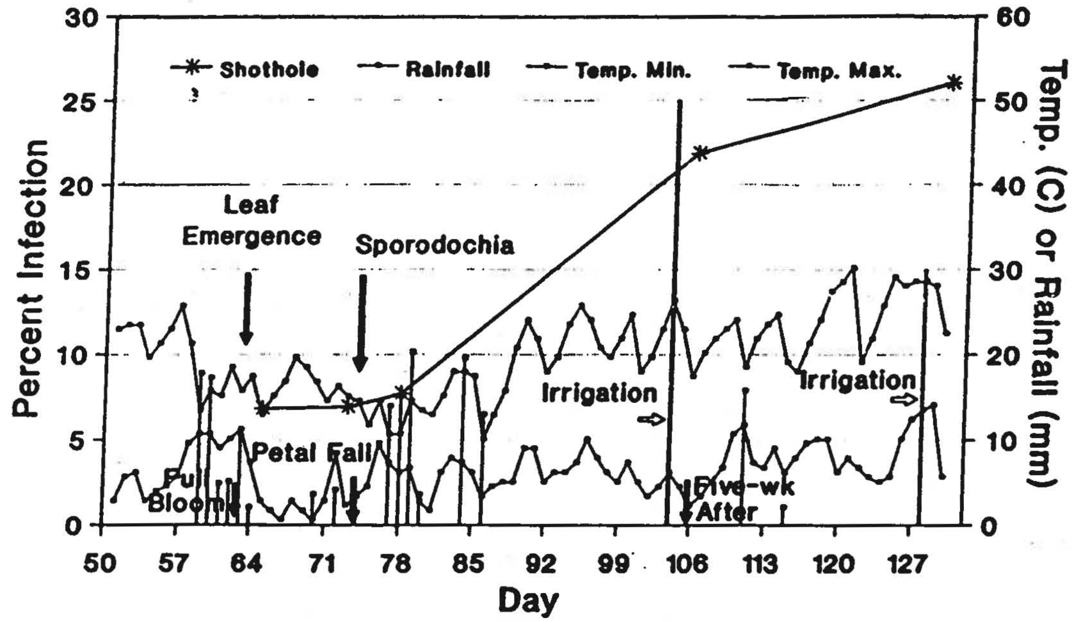
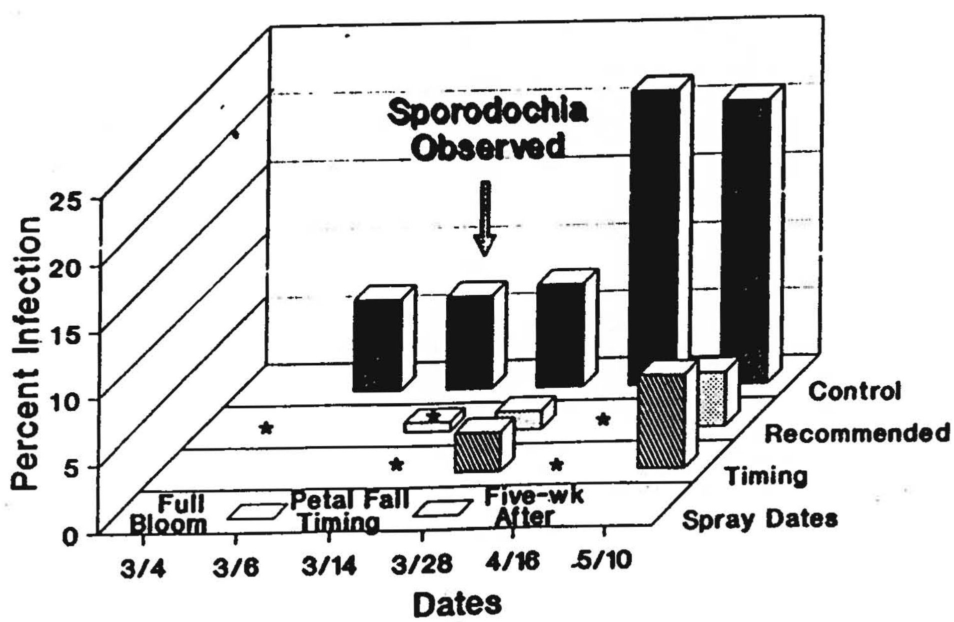


Figure 3.

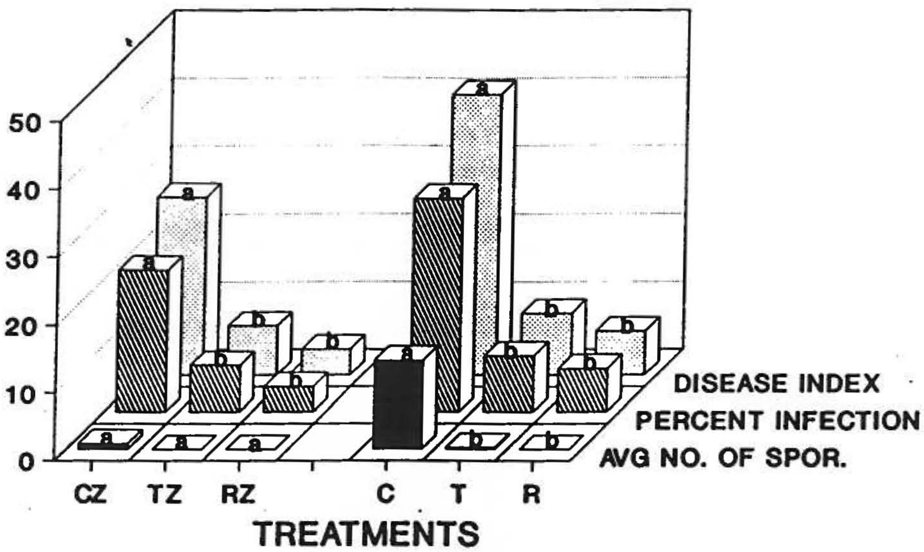
Percent of Almond Leaves with Shot Hole Merced Co. - Spring 1991



Fungicide = Ziram.

Figure 4.

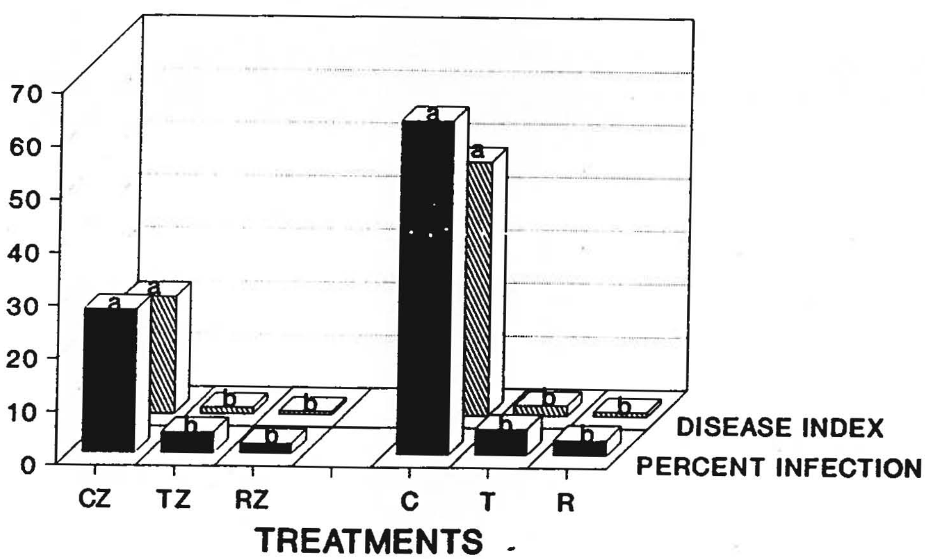
PERCENT ALMOND LEAVES WITH SHOTHOLE
Merced Co. - Spring 1991



Z = Ziram applied at 5-wk after petal fall.

Figure 5.

PERCENT ALMOND FRUIT WITH SHOTHOLE
Merced Co. - Spring 1991



Z = Ziram applied at 5-wk after petal fall.

Figure 6.
Temperature, Rainfall, and Incidence of Shothole - Butte County/Spring 1991

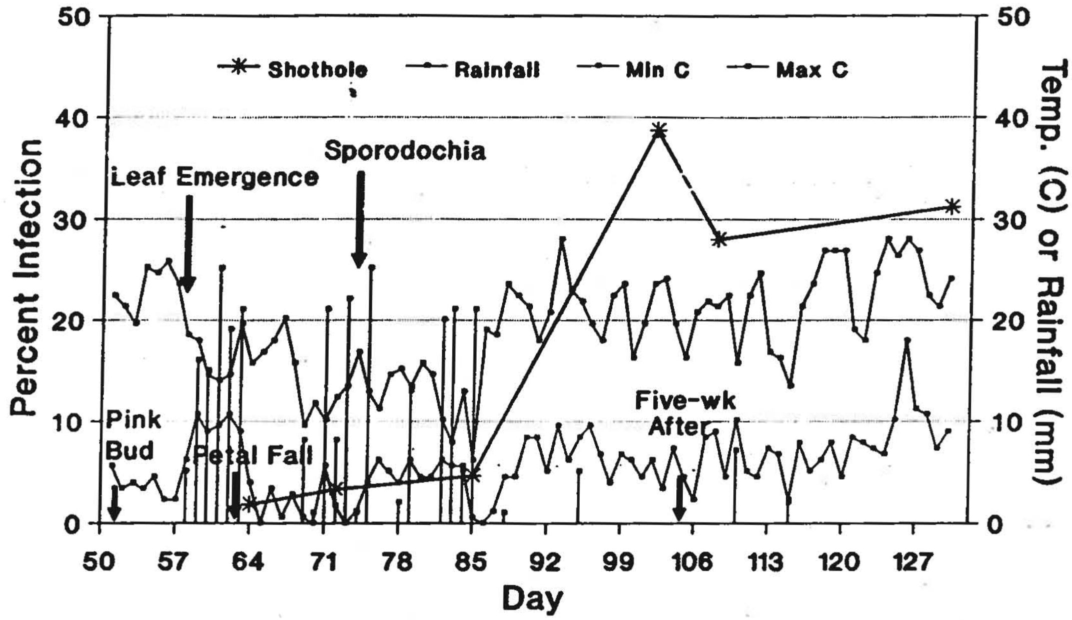
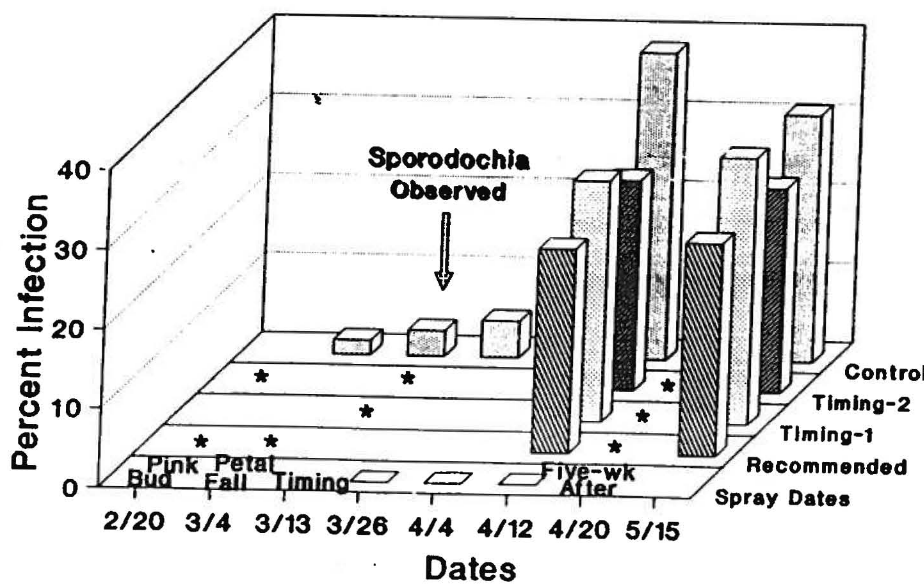


Figure 7.
Percent of Almond Leaves with Shot Hole Butte Co. - Spring 1991



Fungicide = Ziram.

Figure 8.
Temperature, Rainfall, and Incidence of Shothole - Kern County/Spring 1991

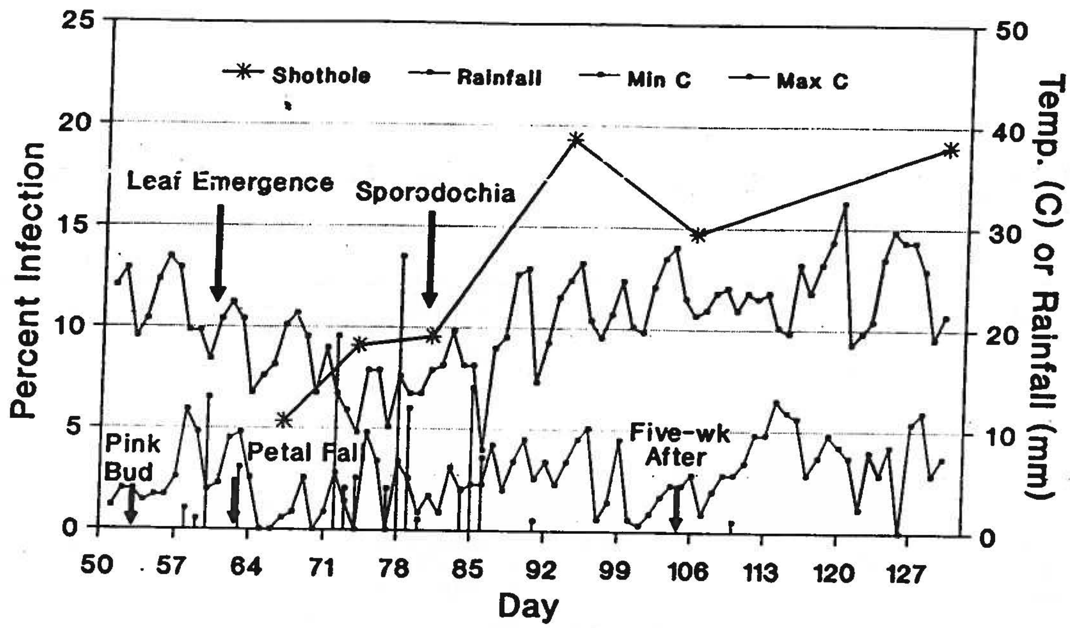
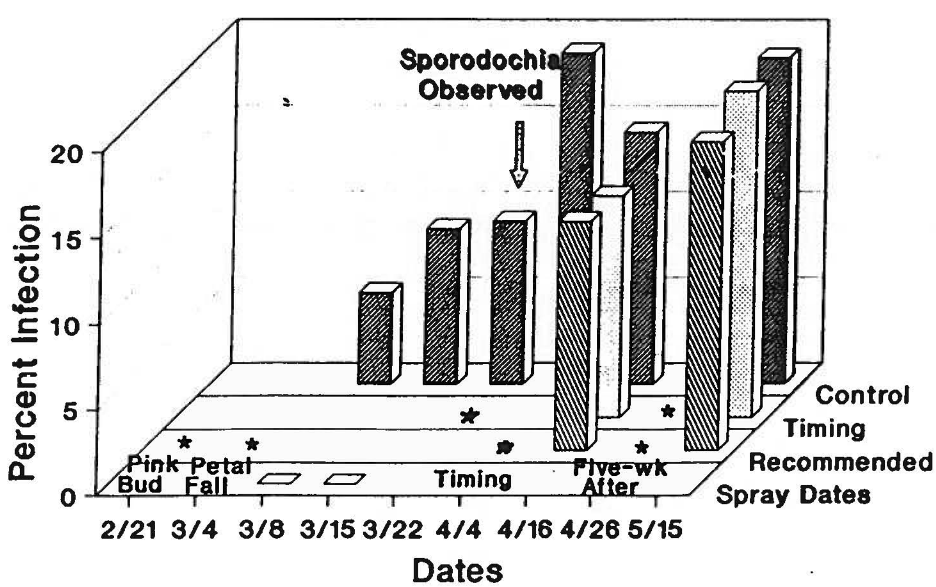


Figure 9.
Percent of Almond Leaves with Shot Hole Kern Co. - Spring 1991



Fungicide - Ziram.

Figure 10.

Temperature, Rainfall, and Incidence of Shothole - Solano County/Spring 1991

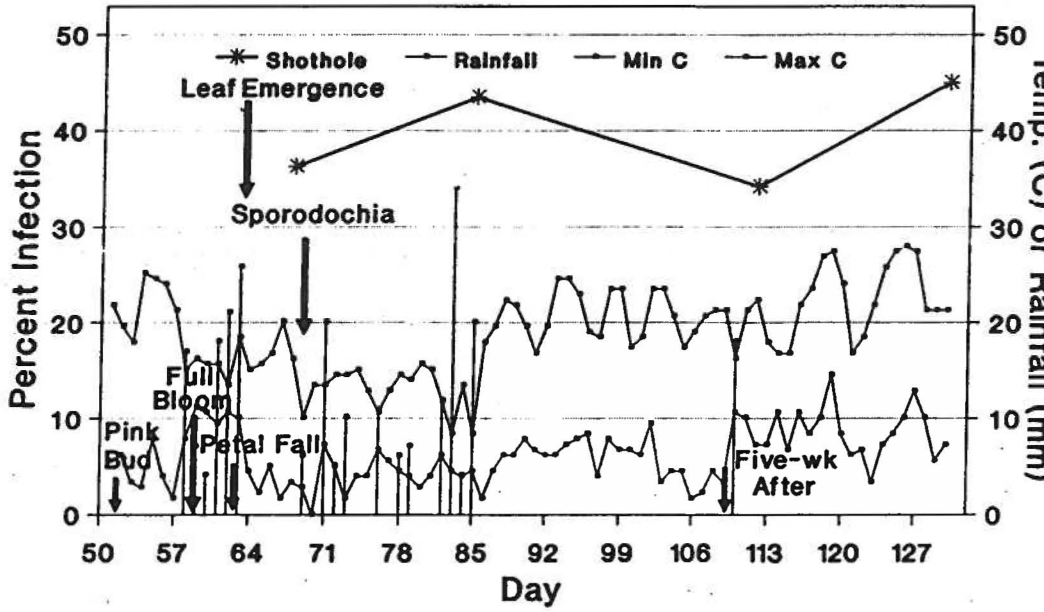
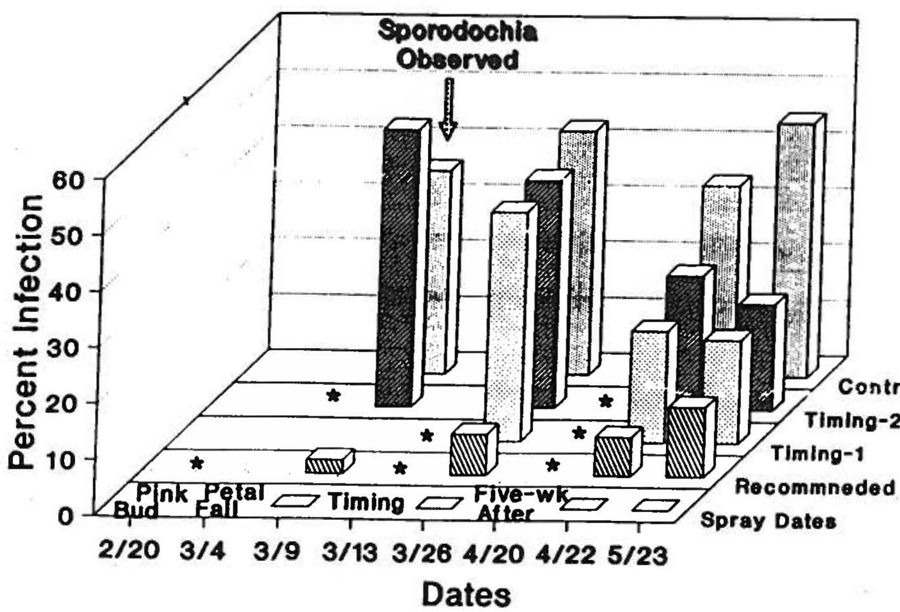


Figure 11.

Percent of Almond Leaves with Shot Hole Solano Co. - Spring 1991



Fungicide = Ziram.

Figure 12.
Percentage of Fallen Leaves with Shothole as Influenced by Fungicide Treatments

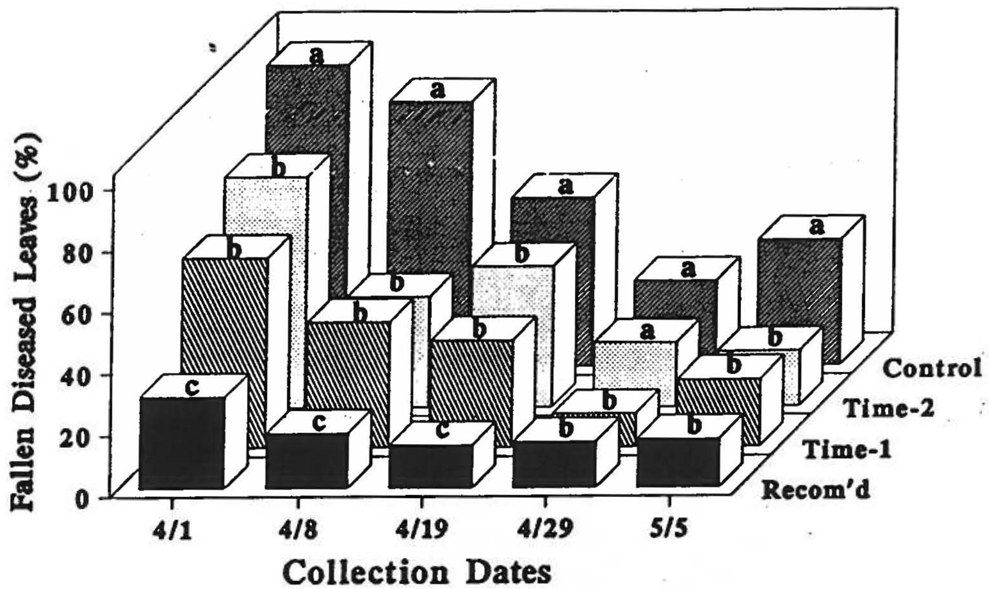


Figure 13.
Average Leaf Drop as Influenced by Shothole Incidence and Fungicide Treatments

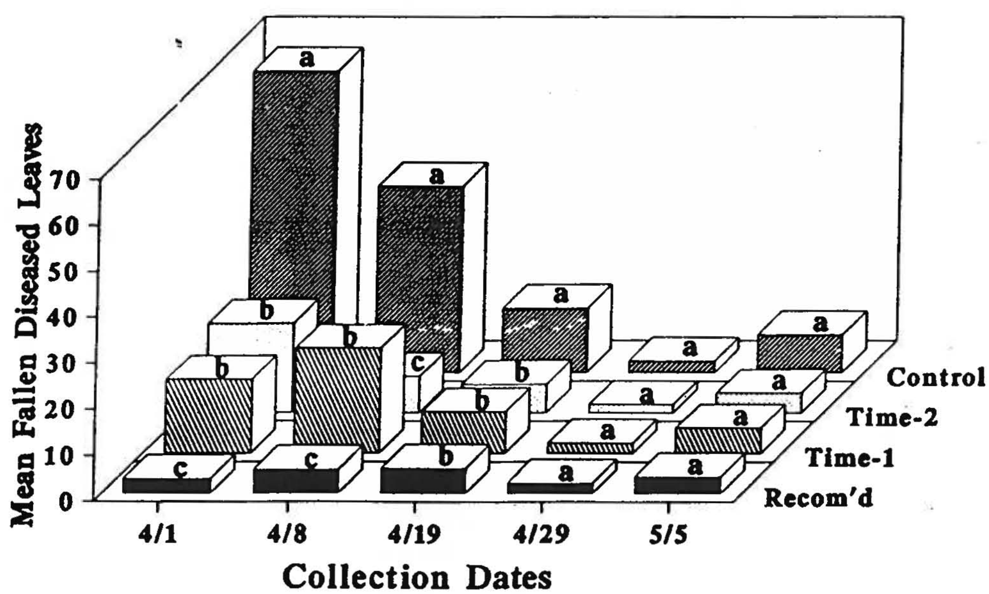


Figure 14.
Percentage of Fruit with Shothole as Influenced by Fungicide Treatments

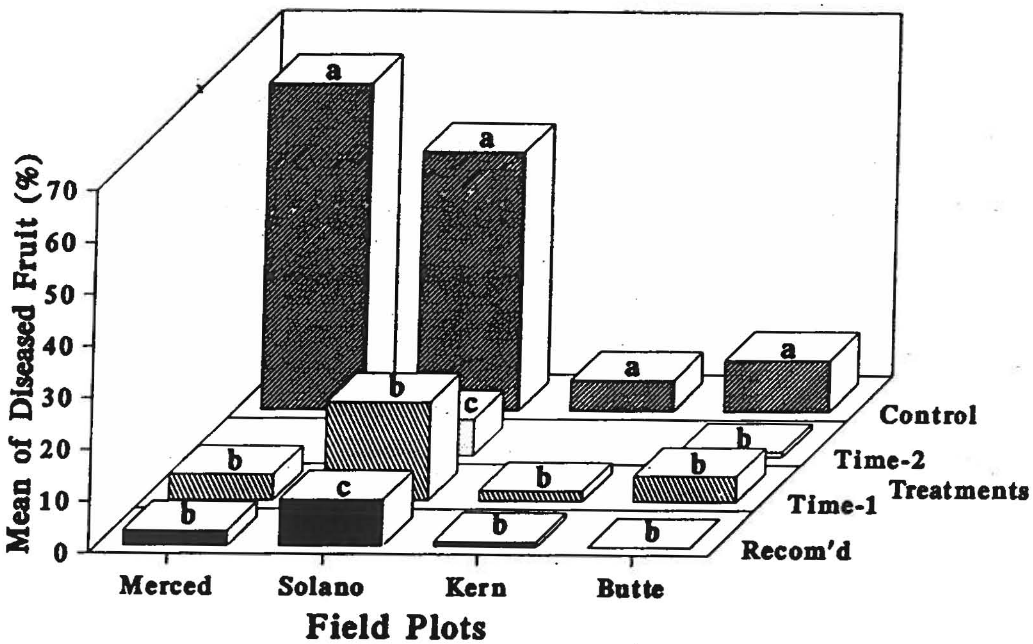


Figure 15.
Disease Severity of Fruit with Shothole as Influenced by Fungicide Treatments

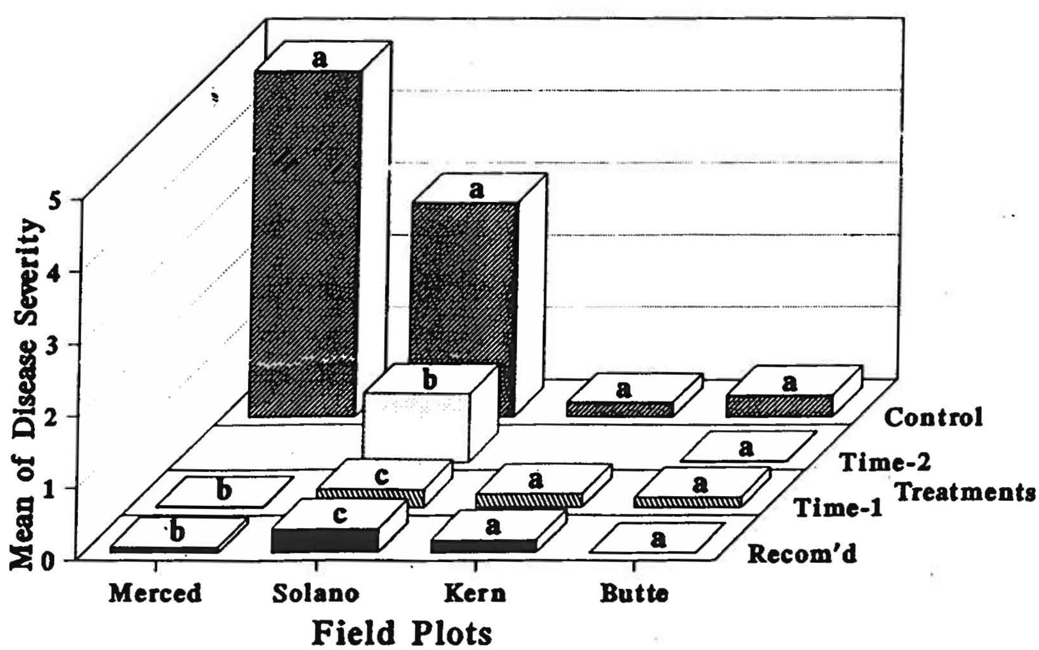
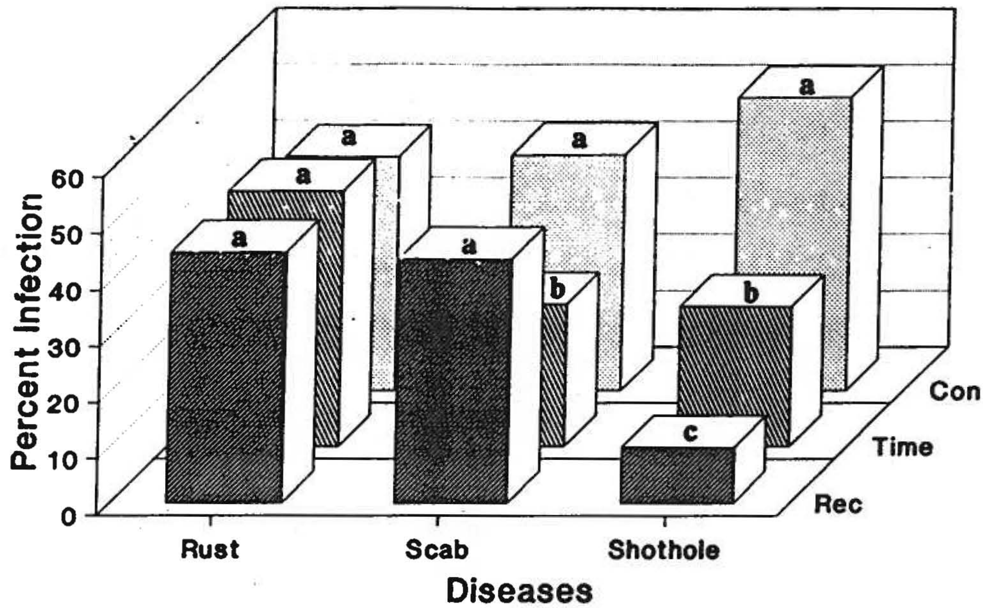


Figure 16.

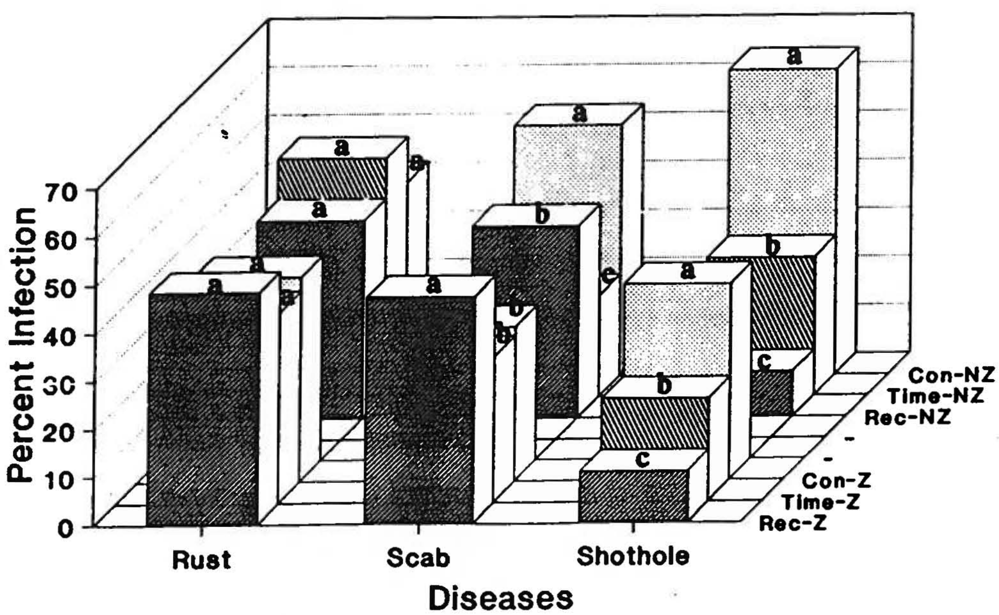
Incidence of Rust, Scab, and Shothole Merced County - Fall 1991



Fungicide ▪ Ziram.

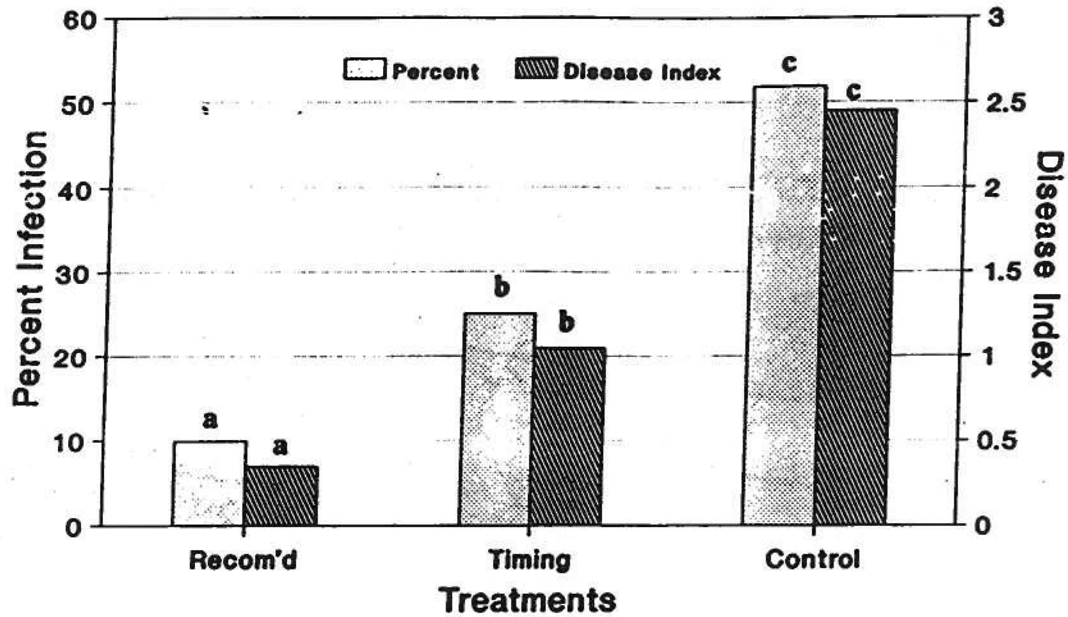
Figure 17.

Incidence of Rust, Scab, and Shothole Merced County - Fall 1991



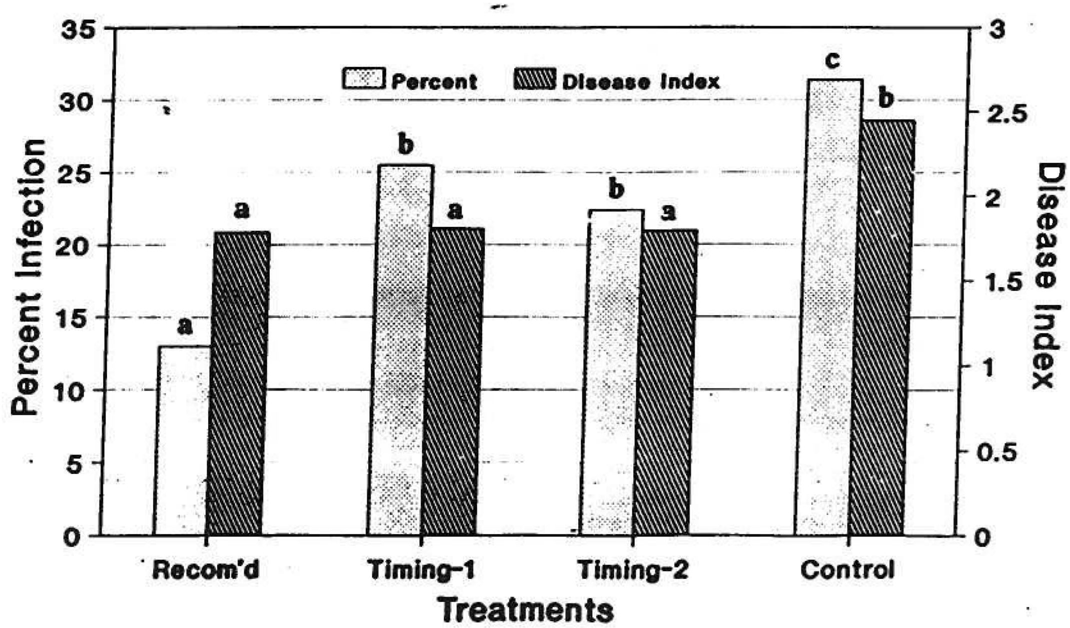
Fungicide ▪ Ziram.

Figure 18.
Shothole Incidence and Disease Severity Merced County, Fall 1991



Fungicide = Ziram.

Figure 19.
Shothole Incidence and Disease Severity Solano County, Fall 1991



Fungicide = Ziram.