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Project No. 96-JA2: Host Resistance and Chemical Management Strategies for Brown Rot Blossom Blight of Almond.

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SUMMARY

Brown rot blossom blight caused by *Monilinia* species is one of the major diseases of almond in California and potentially can cause extensive crop losses. In 1996 and 1997, we have conducted research to develop reduced-spray programs for brown rot management based on identification of new fungicides (e.g., propiconazole, tebuconazole), improved efficacy of registered fungicides (e.g., iprodione-oil mixtures), and development of new application schedules (e.g., susceptible-row spray programs). In the last two years, with the cooperation of Joe Connell (UCCE-Butte County), Mario Viveros (UCCE-Kern Co.), Dr. Tom Gradzeil, and Extension Specialist Warren Micke, we initiated research to evaluate relative brown rot susceptibility in new almond varieties that are also being horticulturally and pomologically evaluated in two variety trials in Butte and Kern Co. In initial field and laboratory studies, Nonpareil was less susceptible, Mission was variable, and NePlus Ultra, Butte, and Carmel were more susceptible to brown rot. Information on new fungicides, fungicide application programs, and varietal susceptibility to brown rot and other diseases in these advanced variety trials will be beneficial to growers that are planting new selections and to breeders that are planning and developing future varieties.

INTRODUCTION

Brown rot blossom blight caused by *Monilinia* species is one of the major diseases of almond in California and potentially can cause extensive crop losses. In the past several years, we have conducted research to develop reduced-spray programs for brown rot control based on improved efficacy of fungicides (e.g., iprodione-oil mixtures), identification of differences in cultivar susceptibility, and development of new application schedules (e.g., susceptible row spray programs). These studies were conducted to develop integrated approaches for brown rot blossom blight management in almond. In host resistance studies, comparisons of inoculation methods were made on the equivalent phenological stage of blossom development based on early, mid-, and late blooming varieties. Because of the enormous potential for variation in environmental conditions and bloom dates between varieties during the spring from year to year and between research sites, our research approach was to evaluate almond varieties in the regional varietal trials using several different methods of evaluation. These methods included: natural incidence of brown rot, pink bud and blossom inoculations in the field, and laboratory inoculations using detached blossoms. Varieties evaluated for natural incidence of brown rot were Aldrich, Butte, Carmel, Fritz, Mission, Monterey, Nonpareil, Padre, Price, Rosetta, Sonora, Wood Colony, 1-87, 1-102, 2-19, 2-43, 13-1, and 25-75. In

previous years, studies that utilized direct pink bud inoculations gave consistent results for incidence and severity of brown rot between the two plots as compared to studies that utilized inoculation and bagging of blossoms in full bloom or the use of detached blossoms in laboratory inoculations. In the pink bud inoculations, significant differences in brown rot incidence were observed among varieties combined from both plots. Aldrich, Fritz, Price, Sonora, Wood Colony, and 13-1 were significantly higher in disease incidence than Nonpareil, 1-102, and 2-19. Some varieties, however, had more disease in Butte than in Kern Co. and a significant interaction was observed between varieties and plot location. In comparisons of severity or those infections that resulted in a stem lesion, Aldrich, Butte, Fritz, Price, Sonora, Wood Colony, and 13-1 had the largest stem lesions. Again, Nonpareil, 2-19, and 1-102 had the smallest lesions that resulted from pink bud inoculations. Preliminary histological studies showed that blossoms of Nonpareil formed a clear zone and latter an abscission zone in the bud-stem union that inhibited blossom infections from entering the stem. In fungicide studies comparing iprodione and myclobutanil with and without 2% summer oil (Omni Supreme Oil), all treatments significantly reduced blossom blight compared to the check. The oil emulsion significantly improved the efficacy of iprodione but not that of myclobutanil. In evaluations of susceptible-row application of fungicides for brown rot blossom blight control on almonds, no significant difference in disease incidence (less than 0.1% in all treatments) or in crop yield for the cultivar Nonpareil was observed between fungicide treated (12.8 lbs of kernels/tree) and non-treated (13.3 lbs of kernels/tree) trees. For cultivar Carmel, however, yield for the iprodione-oil treatment (13.54 lbs/tree) was significantly higher than that of non-treated trees. Thus, as expected, susceptible varieties such as Carmel need to be protected with fungicides to prevent yield losses from brown rot, whereas Nonpareil trees may not need fungicide application in years of low disease pressure.

In 1997, we continued to evaluate the effect of oil emulsions in combination with iprodione or other fungicides such as myclobutanil, and we evaluated new fungicides currently being developed for almond disease management. Additionally, we continued our research on varietal susceptibility to brown rot.

OBJECTIVES

1. Evaluate natural host resistance and relative brown rot susceptibility in almond cultivars planted in varietal blocks in Kern and Butte Counties.

2. Development of efficacy data for brown rot control using new fungicides, fungicide-additive combinations, and susceptible-row application of fungicides for brown rot blossom blight control on almonds.

MATERIALS AND METHODS

I. *Natural host resistance*

Pink bud inoculations. Thirty-five buds each on individual spurs on three single-tree replications of each cultivar were individually inoculated at pink bud stage (5% open blossoms) with 20 µl of a 50,000 spores/ml suspension of *Monilinia laxa* using a 1.0 ml syringe and 27 gauge needle. Incidence of brown-rotted blossoms was recorded weekly for 3-4 weeks. Severity of brown rotted stems infections was recorded by measuring the length of twig cankers. Treatments were compared using analysis of variance or general linear model and least significant difference (LSD) procedures for multiple comparisons of means using SAS 6.04.

Open bloom inoculations - field. Two branches each with 10 - 20 open blossoms on three trees of each cultivar were manually inoculated at full bloom stage (80%+ open blossoms) by spraying

blossoms with a 30,000 spores/ml suspension of *Monilinia laxa* with a hand-held spray bottle. Unopened buds were removed and sprayed branches were then double bagged with a plastic bag with added distilled water and a wet paper towel, and a paper bag to protect the inoculations from radiant heat. Incidence of brown-rotted blossoms was recorded weekly for 3-4 weeks. Severity of brown rotted stems infections was recorded by measuring the length of twig cankers. Treatments were compared using analysis of variance or general linear model and least significant difference (LSD) procedures for multiple comparisons of means using SAS 6.04.

Open bloom inoculations - laboratory. Several branches with pink buds, but with open blooms removed, from three trees of each cultivar were returned to the laboratory in a cold box. Branches were cut at the base, placed in fresh water, and forced open at room temperature. Eighteen to twenty-four open blooms from each cultivar were then removed, placed on moist vermiculite, and sprayed to run off with an aqueous suspension of *M. laxa* conidia (15,000 spores/ml). Treatments were compared using analysis of variance or general linear model and least significant difference (LSD) procedures for multiple comparisons of means using SAS 6.04.

Natural incidence of brown rot caused by M. laxa – field. All cultivars were evaluated for natural incidence of blossom blight disease. Two hundred blossoms on each of three trees(reps)/treatment were rated for incidence of brown rot. Treatments were compared using analysis of variance or general linear model and least significant difference (LSD) procedures for multiple comparisons of means using SAS 6.04.

Histology. Almond stems, including axillary regions with attached inoculated and non-inoculated blossoms were excised in the field and immersed in either 2.5% glutaraldehyde in phosphate buffer or in Carnoy-Lebrun fixative. Specimens initially fixed in glutaraldehyde were later transferred to Carnoy-Lebrun. Following 2-3 days in Carnoy-Lebrun fixative, specimens received three one hour rinses in 95% ethanol, were trimmed to smaller sizes, and immersed for 3-4 days in Sinha's modified version of Mukerji's solution for softening. After softening, specimens were rinsed in 3 changes of 95% ethanol, and transferred in sequence through 100% ethanol, 100% ethanol + TBA (1:1), three rinses of 100% TBA. Infiltration was initiated with TBA + paraffin oil (1:1) in the vacuum oven. Three to four changes in melted paraffin in the vacuum oven preceded final embedding in paraffin. Sections, 10 µm in thickness, were made using an American Optical Spencer 820 microtome. Ribbons were mounted on glass slides with Mayer's egg albumin adhesive. Sections were deparaffinized with xylene, rehydrated through ethanol to 70%, and stained 36-48 hours in safranin, followed by counter staining in fast green (Johansen, 1940). Final dehydration was with ethanol and final clearing with xylene. Cover glasses were mounted with Permount. Photographs were taken using Zeiss Axioscope and Zeiss camera at 400x magnification on Kodak Ektachrome film, digitized using Photoshop and a slide scanner and printed on a Sony D8800 dye-sublimation printer.

II. ***Fungicide Evaluations***

Evaluation of fungicides for brown rot management. Drake almond trees planted at the Department of Plant Pathology Research Field at the University of California, Davis were used for these studies. A randomized plot of four single-tree replications for each treatment was used. Fungicides were applied using a 3.5 gal capacity, back-pack sprayer calibrated for 100 gal/A. The following fungicide products were evaluated: Rally 40W, RH141647-8 30EC, Rovral 50WP (iprodione), Abound 2F, Break 50WP, Switch 62.5WP, Elite 45DF, and Vangard 75WP. Additives used with designated treatments were Omni Supreme Spray Oil, Kinetic, or Latron CS-7. In a second study, selected rates of Rally and

RH141647-8 30EC were evaluated. In both studies, treatments were applied at pink bud and full bloom and there were four (study 1) and three (study 2), single-tree replications per treatment. For both studies, brown rot twig and spur blight caused by *Monilinia laxa* were evaluated based on 200 spurs/tree in early April. Treatments were compared using analysis of variance or general linear model and least significant difference (LSD) procedures for multiple comparisons of means using SAS 6.04. Flowering stages were recorded by date for each *Prunus* species studied.

Break 50WP was evaluated for 'kick-back' action or applications of fungicide after an infection period. For this, treatments were applied to Drake almonds using a back-pack air-blast sprayer at 24, 48, or 96 hr intervals after blossoms were inoculated with a conidial suspension of *M. laxa* (20K/ml). A similar study was done in the laboratory using detached Drake almond blossoms but treatments were applied at 16, 24, or 40 hours after inoculation. Biologicals were also evaluated and compared to Break 50WP. Treatments were applied using an air-blast back pack sprayer calibrated for 100 gal/A. blossoms were inoculated with an aqueous suspension of conidia (25K/ml) of *M. laxa*. After inoculation, blossoms were bagged for 18 hrs or sprinkler irricated for 8 hrs. After 10 days, disease incidence was determined based on 30 blossoms inoculated for each of 4 single-tree replications.

Evaluation of a susceptible-row spray program for brown rot management. A Nonpareil-Carmel-Monterey (50-25-25%) almond orchard in Bakersfield, CA was used for this study. Rows of Nonpareil (30 trees/row) were flanked by rows of Carmel and Monterey (both 29 trees/row) cultivars. In half of the plot, alternate rows of susceptible cultivars, Carmel and Monterey were sprayed, whereas Nonpareil rows were not sprayed. In the second half of the plot, all rows were sprayed. Fungicide treatments were iprodione (Rovral 50WP; 1 lb/acre) and myclobutanil (Rally 40WP; 6 oz/acre) each with and without 1.5% summer oil. Control rows were not sprayed. Each treatment had 4 single row replications. Commercial harvesters were used to harvest the almonds from each row (rep) into a gondola; four reps/treatment. Each gondola used was tared and gross weight of each gondola used was recorded. Net weight of row yield was calculated by subtracting the tare weight from the gross weight. Four-pound sub-samples were taken from each row harvested. Total nuts were counted from each four-pound sample, and from these, 100 nut meats were weighed for final yield calculations per tree.

RESULTS AND DISCUSSION

Evaluations of natural host resistance and relative brown rot susceptibility in almond cultivars planted in varietal blocks in Kern and Butte counties. In varietal field evaluations, enormous potential for variation can occur between trials. Different cultural practices, environmental conditions, and inherent differences in bloom dates between varieties and research sites occurred in each year of our study. Thus, our research approach was to evaluate almond varieties in the regional varietal trials using several different methods of evaluation including natural incidence, pink bud and full bloom field inoculations, and laboratory full bloom inoculations using detached blossoms. Varieties evaluated for brown rot susceptibility were Aldrich, Butte, Carmel, Fritz, Mission, Monterey, Nonpareil, Padre, Price, Rosetta, Sonora, Wood Colony, 1-87, 1-102W, 2-19E, 2-43W, 13-1, and 25-75. In 1997, evaluations for natural incidence of brown rot indicated that less than 1% brown rot blossom blight occurred among the 18 varieties evaluated in each of the two plots. Natural incidence of brown rot was low because of the unusually dry spring. In Kern Co. and Butte Co, approximately 0.17 and 0.53 inches of precipitation occurred during bloom and petal fall in 1997 as compared to 1.86 and 2.6 inches of rain in 1996, respectively (Fig. 1). In 1996, early to mid-blooming varieties Sonora, Price and 2-43 had significantly higher incidence of disease than the mid- to late blooming varieties Nonpareil, 2-19, and 1-102. Other varieties were intermediate in disease incidence.

In comparisons of inoculation methods, inoculations were made on the equivalent phenological stage of blossom development based on early, mid-, and late blooming varieties. Field evaluations were made 3-4 weeks after inoculation. In 1996, disease values were generally higher in Kern Co. than in Butte Co. due to warmer temperatures in the southern plot. Temperatures were more similar in 1997 and thus, disease incidence was also similar between the two plots. Studies that utilized direct pink bud inoculations gave consistent results for incidence and severity of brown rot between the two plots and only small differences occurred between years. In the pink bud inoculations, significant differences in brown rot blossom blight incidence were observed among varieties combined from both plots (Fig. 2). In 1996 and 1997, Aldrich, Butte, Fritz, Price, Wood Colony, and 25-75 were significantly higher in disease incidence than Nonpareil, Monterey, Rosetta, and 1-102W. Some varieties, however, had more disease in one trial site than the other site. Thus, a significant interaction was observed between varieties and plot location.

In full bloom inoculations studies, branches with 6-10 blossoms that were in full bloom were selected at random and the exact age of each blossom was not known. Old blossoms and non-opened blossoms were removed. Blossoms in earlier stages of development were removed from the branch. In these inoculation studies of blossoms in full bloom for and bagged for 18-24 hrs, incidence and severity of brown rot was variable. Variation, however, was expected due to unknown blossom age and to potential natural inoculum contaminating selected blossoms. Based on full bloom inoculations, Aldrich, Butte, Wood Colony, Price and 2-19E had significantly higher levels of disease than most varieties evaluated (Fig. 3). A break-down of varietal susceptibility for early, mid-, and late-blooming varieties are shown for pink bud inoculations (Figs. 4-6) and for full bloom inoculations (Figs. 7-9).

In comparisons of those infections that resulted in a stem lesion, Aldrich, Price, Sonora, Wood Colony, and 25-75 had the largest stem lesions from pink bud incoluations (Fig. 10). Nonpareil, Monterey, and 1-102W had the smallest lesions that resulted from pink bud inoculations. A break-down of varietal susceptibility to canker development is shown in Figs. 11-13. For full bloom inoculations, 2-43W, 1-87, Sonora and Wood Colony had the largest cankers as compared to Nonpareil, Aldrich, Padre, and 1-102W (Fig. 14). A break-down of varietal susceptibility to canker development is shown in Figs. 15-17.

Similarly, in laboratory studies with detached blossoms that were forced open, incidence of anther infections was less variable as compared to field opened blossoms but higher incidence of disease was observed. All varieties had relatively high levels of disease in these tests with over 50% anther infection occurring in all varieties. Aldrich, Butte, Monterey, Carmel, Price, and 1-87 had the highest anther and petal infection (Figs. 18, 19). Nonpareil had a lower incidence and severity of anther and petal infections than most other varieties, however, disease incidence was high in these laboratory studies (Figs. 18, 19).

Histological studies were done on selected varieties showing significant differences in susceptibility to brown rot in several methods of evaluation. Based on laboratory inoculations, all of the varieties have susceptible blossom tissues (e.g., anthers, stigma, petals), however, several varieties evaluated showed significantly fewer blossom infections that resulted in stem lesions. Upon examination of pink bud and full bloom inoculations in the field, varieties that were more resistant to stem lesions had fewer blossoms that were infected and attached to the stem at the time of evaluation. Preliminary histological studies showed that blossoms of Nonpareil, Rosetta, and 25-75 formed a clear zone consisting of five to six layers of cells and later an abscission zone in the bud-stem union that inhibited blossom infections from entering the stem. This was not observed in Aldrich and Butte and only a narrow clear zone of 1-cell layer was observed subtending blossom attachment in Fritz, Mission, and Carmel varieties. Additionally varieties will be

evaluated to determine if this mechanism can be correlated with the reduced incidence of brown rot infections in almond varieties.

Development of efficacy data for brown rot control using new fungicides, fungicide-additive combinations, and susceptible-row application of fungicides for brown rot blossom blight control on almonds. In Kern Co., studies in 1996 and 1997 were also continued to determine the benefits of a susceptible-row spray program. In one 30 acre orchard planted in 1993, cultivars and planting design were: Nonpareil, Monterey, Nonpareil, and Carmel. All varieties were on Nemaguard rootstock. In half of the block all varieties were treated with one pink bud fungicide application, whereas in the other half of the block only the Carmel and Monterey cultivars were treated. No significant difference in disease incidence (less than 1% in all treatments) or in crop yield was observed between fungicide treated (28.1 lbs of kernels/tree) and non-treated (27.5 lbs of kernels/tree) Nonpareil. Crop yield was based on 8 rows per treatment and 30 trees per row. This was consistent with last year's trial in the same orchard and previous years of research in Merced Co. where disease incidence and crop yield were also evaluated in trials comparing treated and non-treated 12 year-old Nonpareil trees (Almond Reports 1993, 1994).

In additional studies comparing fungicides under high disease pressure, tebuconazole (Elite 45DF), propiconazole (Break 45WP), and iprodione-oil (Rovral 50WP-Omni Supreme Spray Oil), significantly reduced blossom blight compared to the check treatments (Fig. 20A). Break applied after an infection period was very effective in reducing disease (Figs. 21, 22). Additional studies are warrented. Other fungicides evaluated in 1997 in second trial that were also effective for brown rot blossom blight control included the SBI fungicides myclobutanil and RH141647 (Fig. 20B). Azoxystrobin (Abound 2F) and cyprodonil (Vangard 75WP) were less effective, although these fungicides (the former as a different formulation - 80WG) were effective in previous trials (Fig. 20A). In these tests, only treatments that included iprodione or ziram were effective against shot hole (*Wilsonomyces carpophilus*) (Fig. 24).

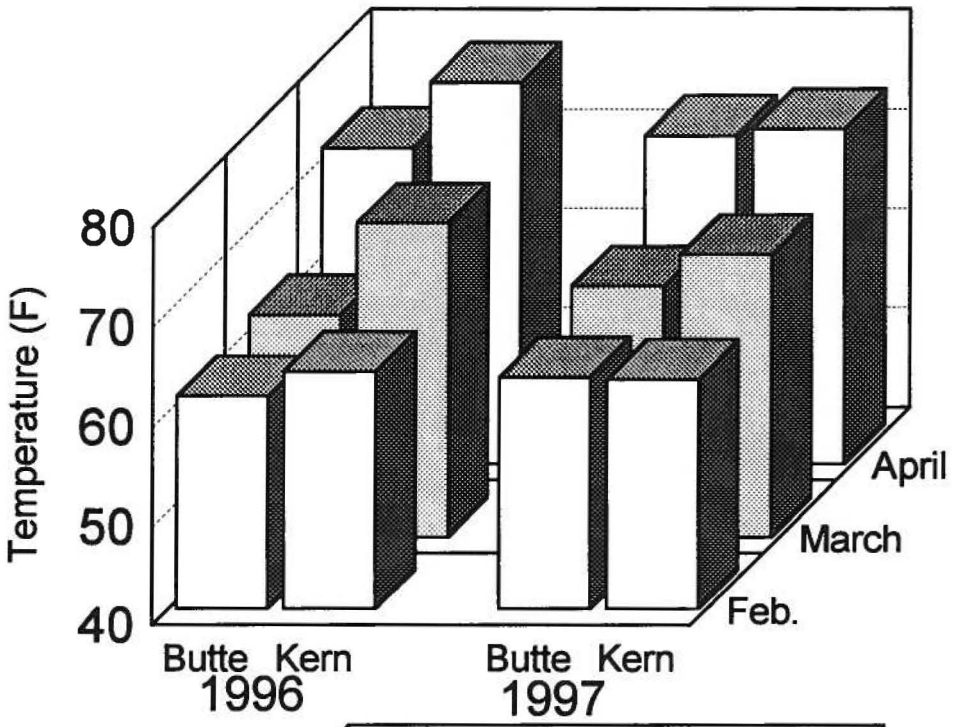
Biological controls evaluated had no effect in reducing brown rot incidence (Fig. 23). These treatments generally increased disease, probably due to the cultural media used to propigate the bacterial biocontrol agent. Break 50WP was the only treatment that significantly reduced incidence of brown rot in this study.

LITERATURE CITED

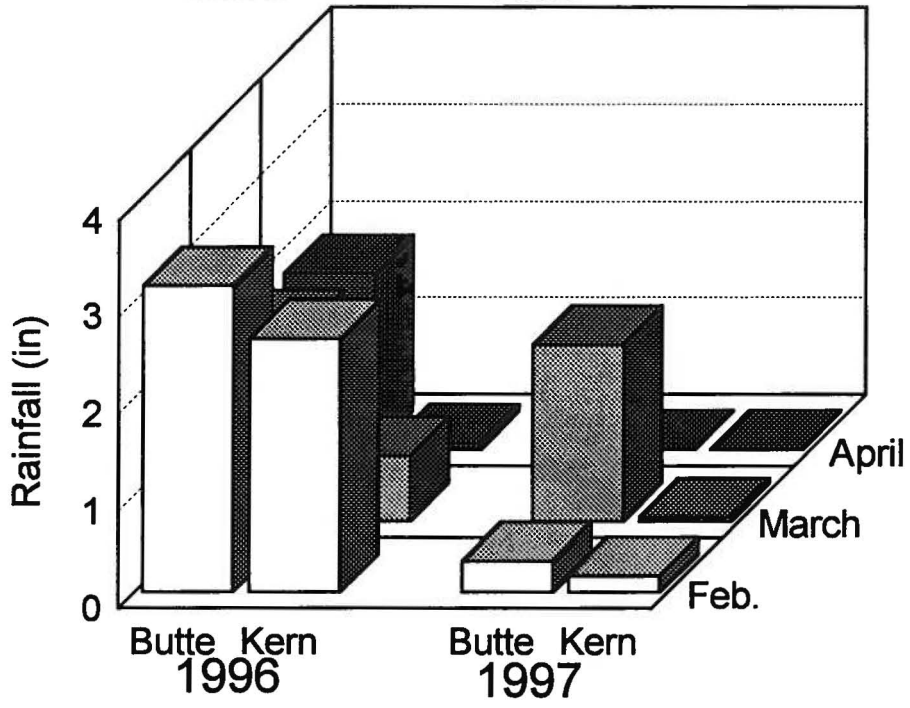
1. Adaskaveg, J. E. and J. M. Ogawa. 1993. *Almond Board Annual Report-1993.*
2. Adaskaveg, J. E. and J. M. Ogawa. 1994. *Almond Board Annual Report-1994.*
3. Johansen, 1940. *Plant Histology.*

Fig. 1. Rainfall and Maximum Temperature Comparisons Between Varietal Plots in Kern and Butte Co.

A. - 1996 and 1997 -



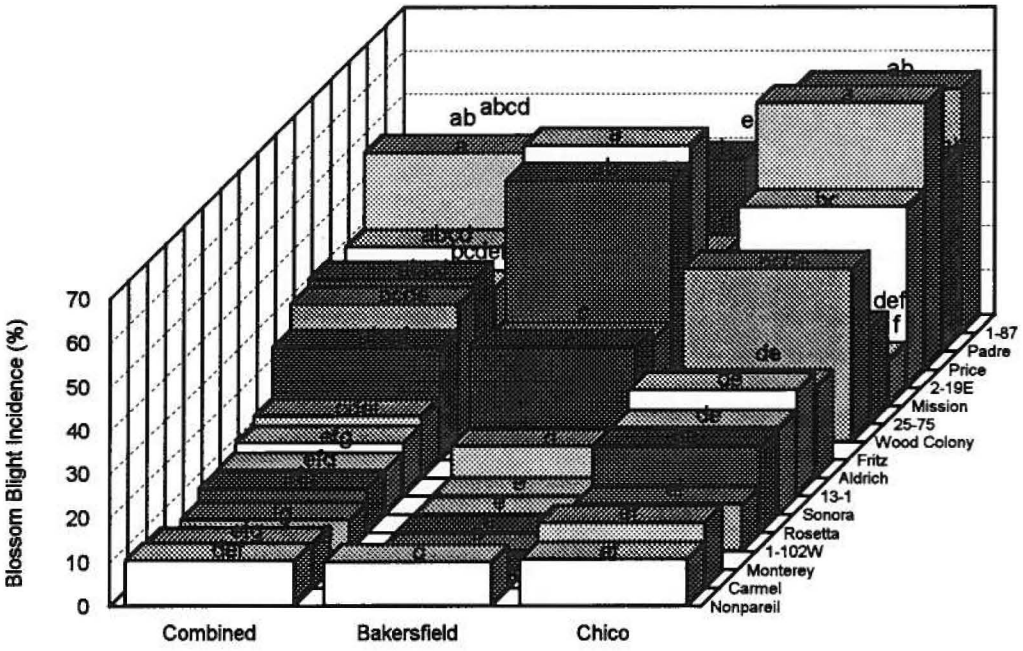
B.



Rainfall and maximum temperature data obtained from CIMIS stations in Chico and Kern counties.

Fig. 2 Incidence of Brown Rot Blossom Blight Caused By *M. laxa* for Selected Almond Varieties

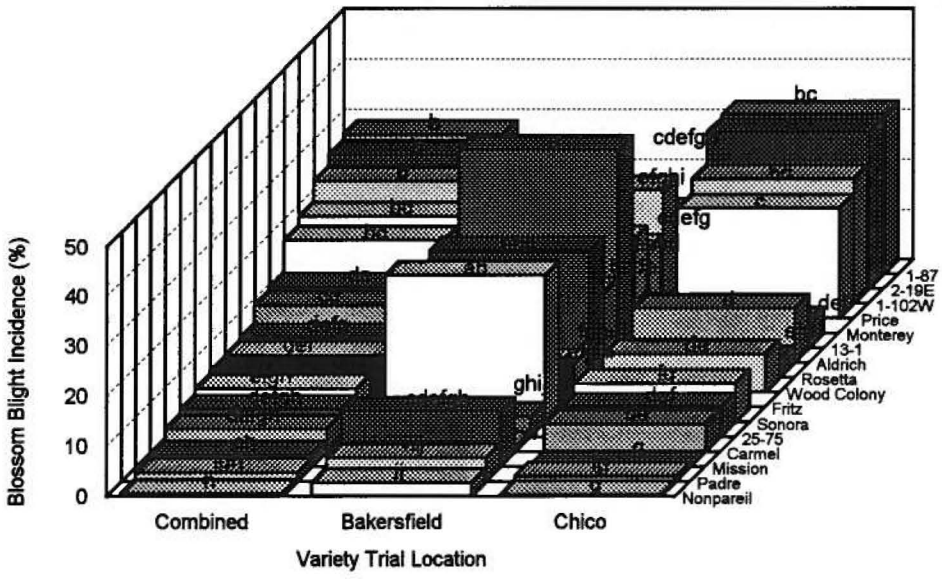
- Pink Bud-Inoculated Blossoms in the Field -



Blossoms in pink bud stage of bloom were inoculated with conidia of *M. laxa* (50K/ml) using a syringe and were evaluated after 3 weeks in the field.

Fig. 3 Incidence of Brown Rot Blossom Blight Caused By *M. laxa* for Selected Almond Varieties

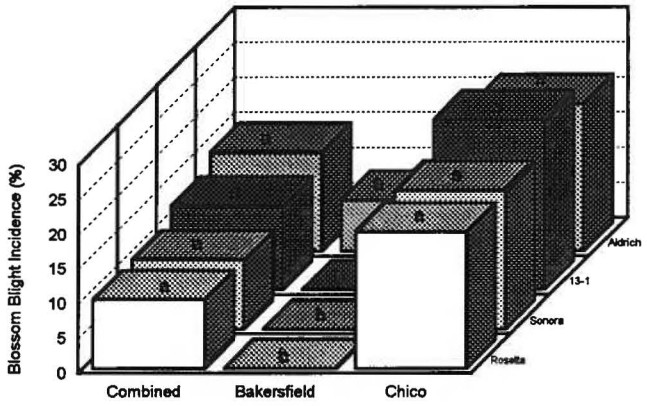
- Full Bloom-Inoculated Blossoms in the Field -



Blossoms in full bloom were inoculated with conidia of *M. laxa* (20K/ml) using a hand sprayer and were evaluated after 3 weeks in the field.

Fig. 4

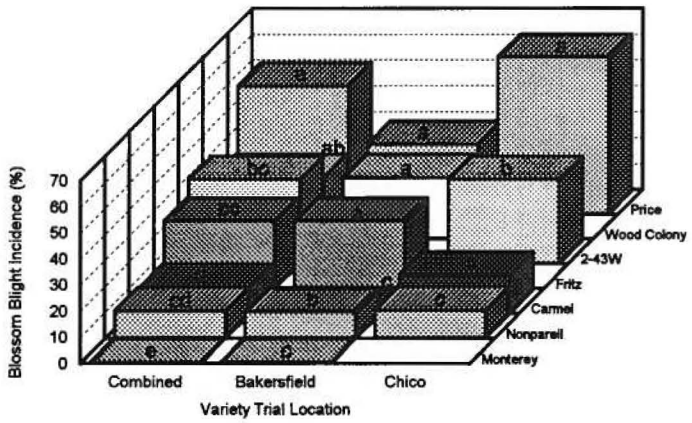
Incidence of Brown Rot Blossom Blight Caused By *M. laxa* for Selected Early-Blooming Almond Varieties
- Pink Bud Inoculated Blossoms in the Field -



Blossoms in pink bud stage of bloom were inoculated with conidia of *M. laxa* (50K/ml) using a syringe and were evaluated after 3 weeks in the field.

Fig. 5

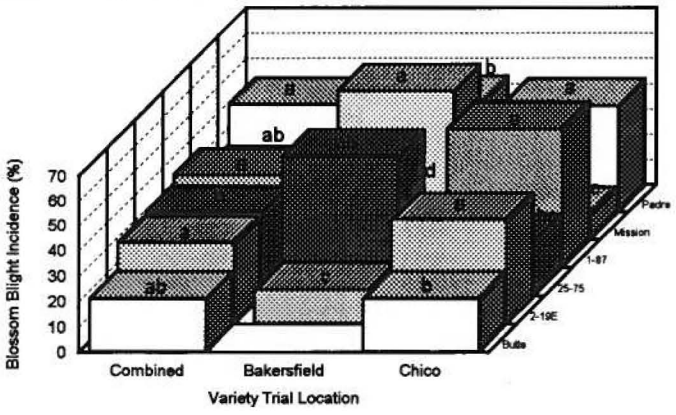
Incidence of Brown Rot Blossom Blight Caused By *M. laxa* for Selected Mid-Blooming Almond Varieties
- Pink Bud Inoculated Blossoms in the Field -



Blossoms in pink bud stage of bloom were inoculated with conidia of *M. laxa* (50K/ml) using a syringe and were evaluated after 3 weeks in the field.

Fig. 6

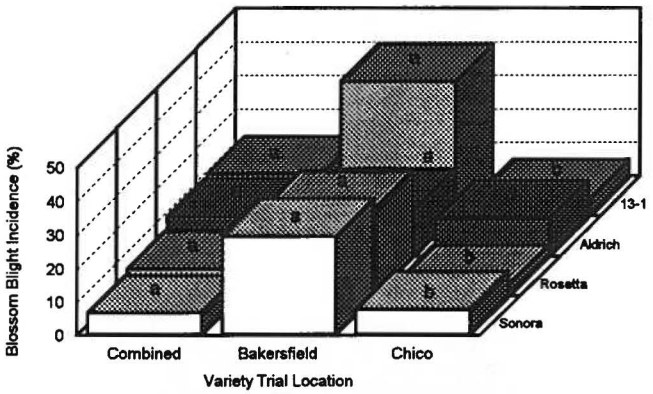
Incidence of Brown Rot Blossom Blight Caused By *M. laxa* for Selected Late-Blooming Almond Varieties
- Pink Bud Inoculated Blossoms in the Field -



Blossoms in pink bud stage of bloom were inoculated with conidia of *M. laxa* (50K/ml) using a syringe and were evaluated after 3 weeks in the field.

Fig. 7

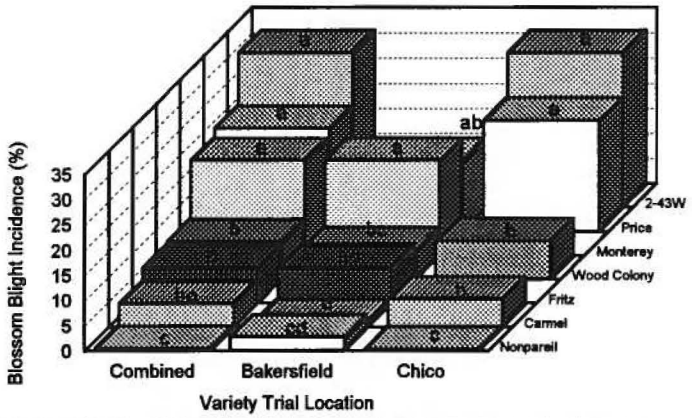
Incidence of Brown Rot Blossom Blight Caused By *M. laxa* for Selected Early-Blooming Almond Varieties
- Full Bloom-Inoculated Blossoms in the Field -



Blossoms in full bloom were inoculated with conidia of *M. laxa* (20K/ml) using a hand sprayer and were evaluated after 3 weeks in the field.

Fig. 8

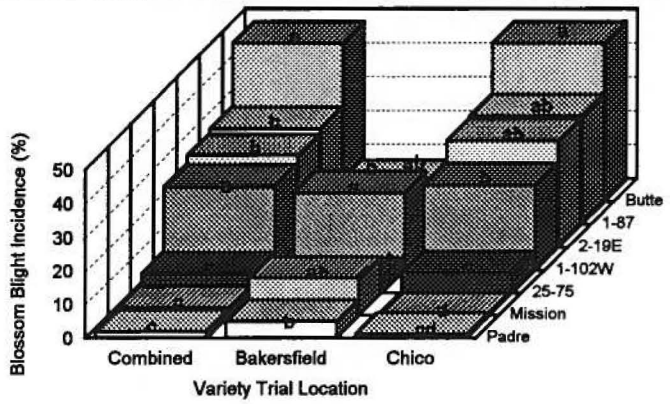
Incidence of Brown Rot Blossom Blight Caused By *M. laxa* for Selected Mid-Blooming Almond Varieties
- Full Bloom-Inoculated Blossoms in the Field -



Blossoms in full bloom were inoculated with conidia of *M. laxa* (20K/ml) using a hand sprayer and were evaluated after 3 weeks in the field.

Fig. 9

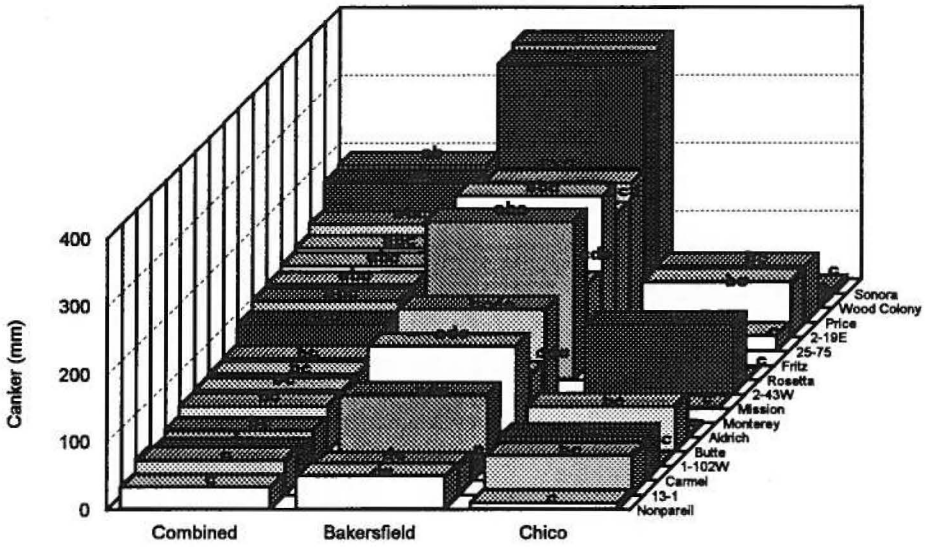
Incidence of Brown Rot Blossom Blight Caused By *M. laxa* for Selected Late-Blooming Almond Varieties
- Full Bloom-Inoculated Blossoms in the Field -



Blossoms in full bloom were inoculated with conidia of *M. laxa* (20K/ml) using a hand sprayer and were evaluated after 3 weeks in the field.

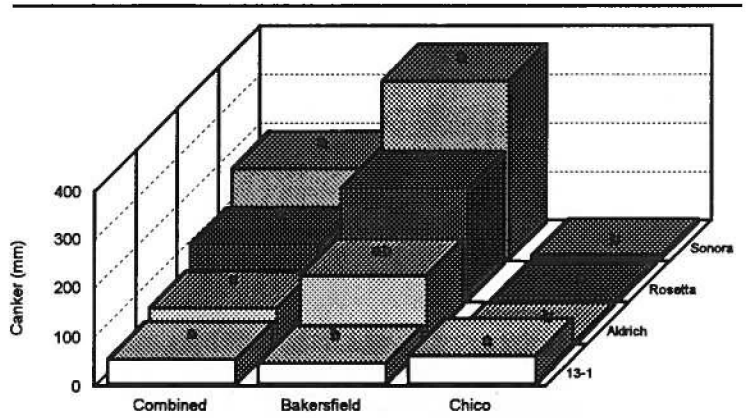
Fig. 10 Severity of Brown Rot Stem Infections Caused by *M. laxa* for Selected Almond Varieties

- Pink Bud-Inoculated Blossoms in the Field -



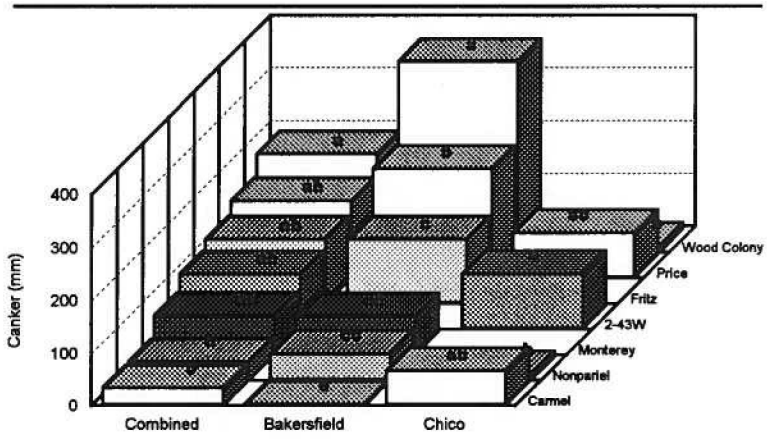
Blossoms in pink bud stage of development were inoculated with conidia (50K conidia/ml) of *M. laxa* in the field using a syringe. Twigs were cut 6 weeks after inoculation and measured for twig canker size in the laboratory.

Fig. 11 Severity of Brown Rot Stem Infections Caused by *M. laxa* for Selected Early-Season Blooming Almond Varieties
- Pink Bud-Inoculated Blossoms in the Field -



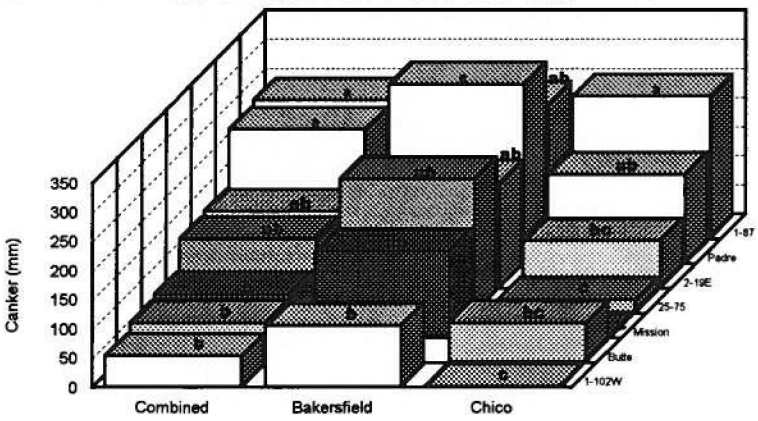
Blossoms in pink bud stage of development were inoculated with conidia (50K conidia/ml) of *M. laxa* in the field using a syringe. Twigs were cut 6 weeks after inoculation and measured for twig canker size in the laboratory.

Fig. 12 Severity of Brown Rot Stem Infections Caused by *M. laxa* for Selected Mid-Season Blooming Almond Varieties
- Pink Bud-Inoculated Blossoms in the Field -



Blossoms in pink bud stage of development were inoculated with conidia (50K conidia/ml) of *M. laxa* in the field using a syringe. Twigs were cut 6 weeks after inoculation and measured for twig canker size in the laboratory.

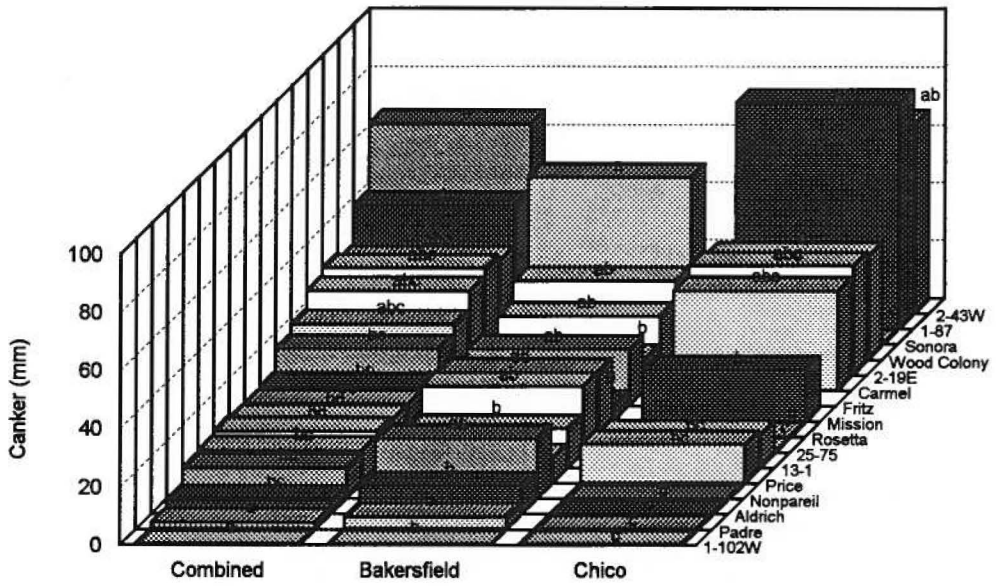
Fig. 13 Severity of Brown Rot Stem Infections Caused by *M. laxa* for Selected Late-Season Blooming Almond Varieties
- Pink Bud-Inoculated Blossoms in the Field -



Blossoms in pink bud stage of development were inoculated with conidia (50K conidia/ml) of *M. laxa* in the field using a syringe. Twigs were cut 6 weeks after inoculation and measured for twig canker size in the laboratory.

Fig. 14 Severity of Brown Rot Stem Infections Caused by *M. laxa* for Selected Almond Varieties

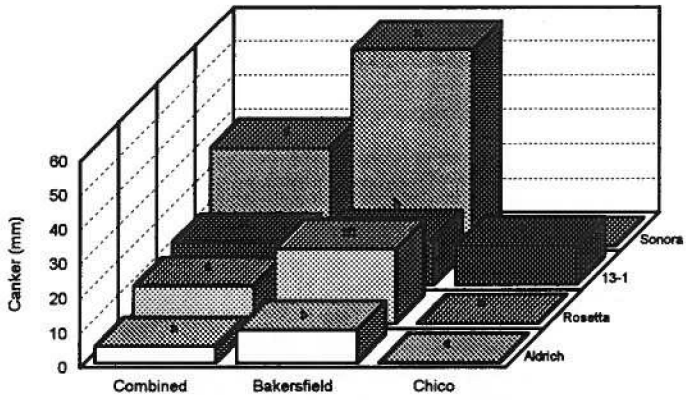
- Full Bloom-Inoculated Blossoms In the Field -



Blossoms in full bloom stage of development were inoculated with conidia (20K conidia/ml) of *M. laxa* in the field. Twigs were cut 6 weeks after inoculation and measured for twig canker size in the laboratory

Fig. 15 **Severity of Brown Rot Stem Infections Caused by *M. laxa* for Selected Early-Blooming Almond Varieties**

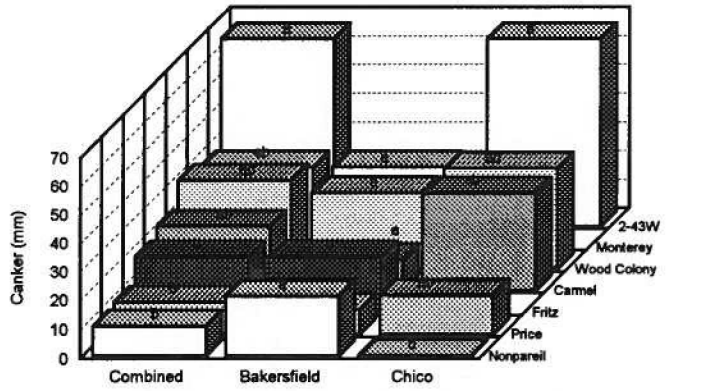
- Full Bloom-Inoculated Blossoms In the Field -



Blossoms in full bloom stage of development were inoculated with conidia (20K conidia/ml) of *M. laxa* in the field. Twigs were cut 6 weeks after inoculation and measured for twig canker size in the laboratory

Fig. 16 **Severity of Brown Rot Stem Infections Caused by *M. laxa* for Selected Mid-Blooming Almond Varieties**

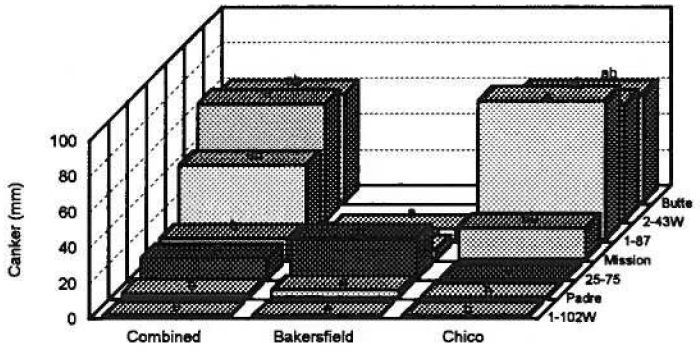
- Full Bloom-Inoculated Blossoms In the Field -



Blossoms in full bloom stage of development were inoculated with conidia (20K conidia/ml) of *M. laxa* in the field. Twigs were cut 6 weeks after inoculation and measured for twig canker size in the laboratory

Fig. 17 **Severity of Brown Rot Stem Infections Caused by *M. laxa* for Selected Mid-Blooming Almond Varieties**

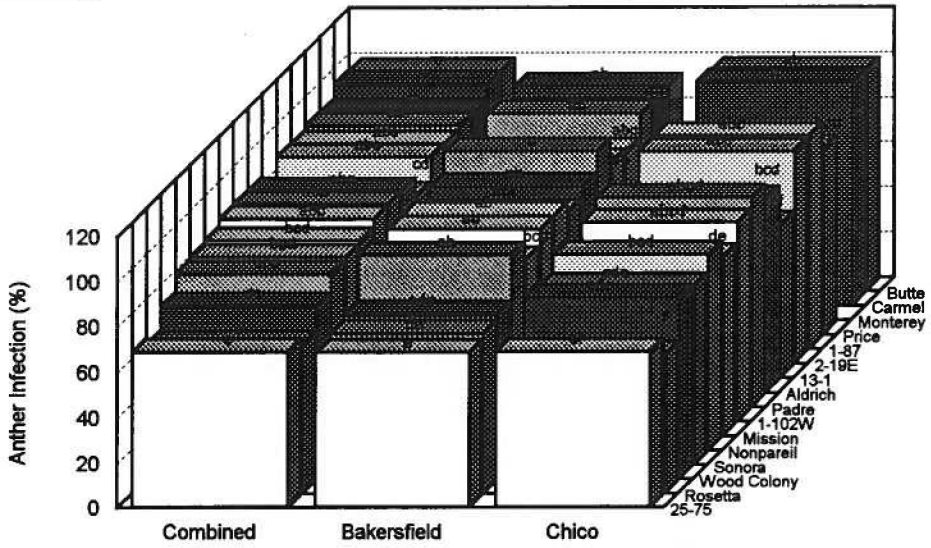
- Full Bloom-Inoculated Blossoms In the Field -



Blossoms in full bloom stage of development were inoculated with conidia (20K conidia/ml) of *M. laxa* in the field. Twigs were cut 6 weeks after inoculation and measured for twig canker size in the laboratory

Fig. 18 Incidence of Brown Rot Anther Infection Caused by *M. laxa* for Selected Almond Varieties

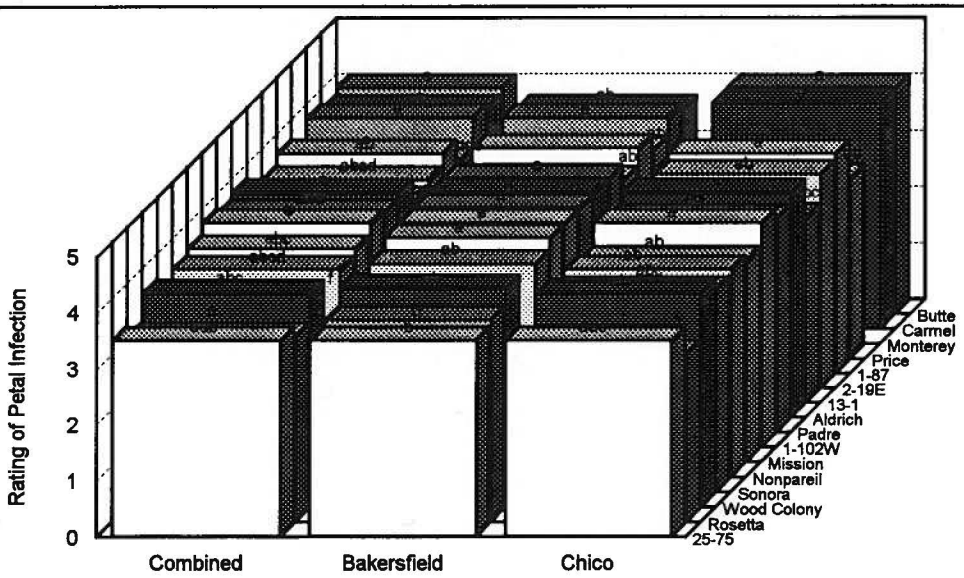
- Laboratory-Inoculated Blossoms -



Blossoms in full bloom stage of development were inoculated with conidia (20K conidia/ml) in the laboratory and incidence of anther infection was determined after 3 days at 20C.

Fig. 19 Incidence of Brown Rot Petal Infection Caused by *M. laxa* for Selected Almond Varieties

- Laboratory-Inoculated Blossoms -

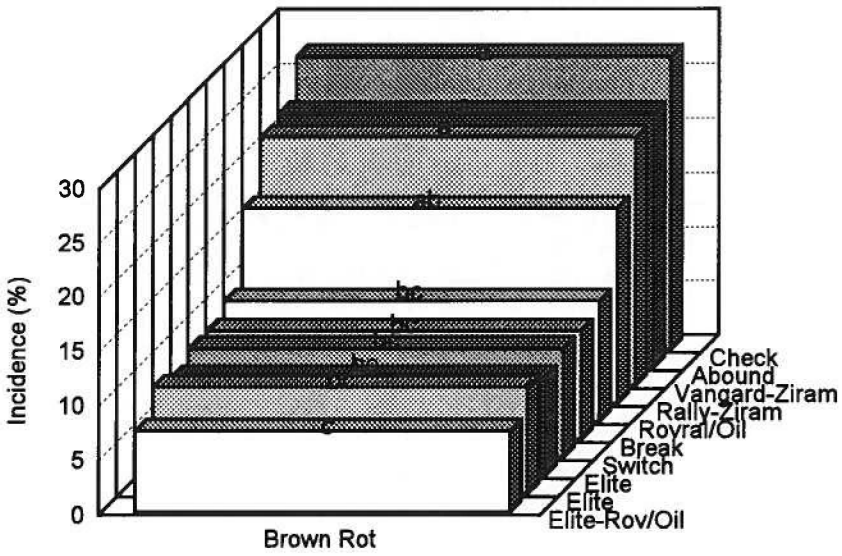


Blossoms in full bloom stage of development were inoculated with conidia (20K conidia/ml) in the laboratory and a rating (0-Healthy to 4-100% Infection) of petal infection was determined after 3 days at 20C.

Fig. 20. Efficacy of Fungicide Treatments for Management of Brown Rot Blossom Blight of Almond

A. Almond B-1

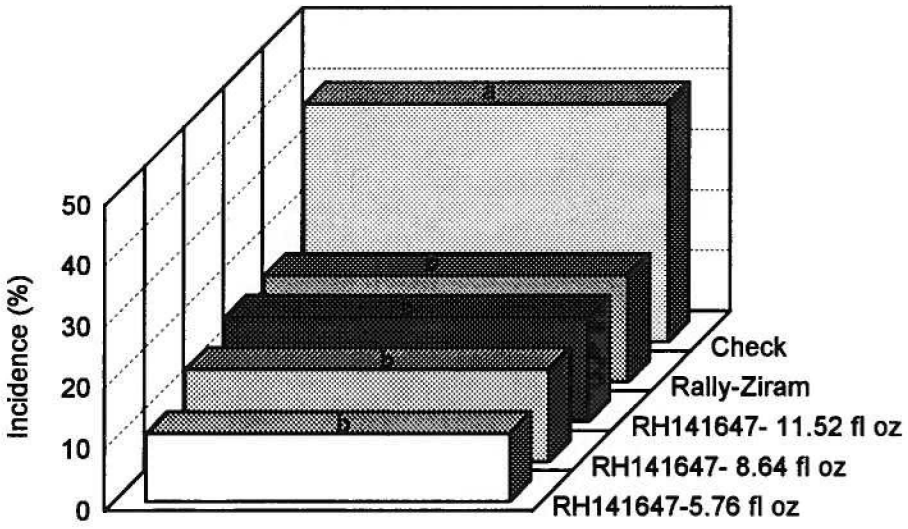
- Spring 1997 -



Treatments were applied using an air-blast, back pack sprayer calibrated for 100 gal/A. Disease incidence was determined based on a 200 spur sample per each of 4 single-tree replications.

B. Almond B-2

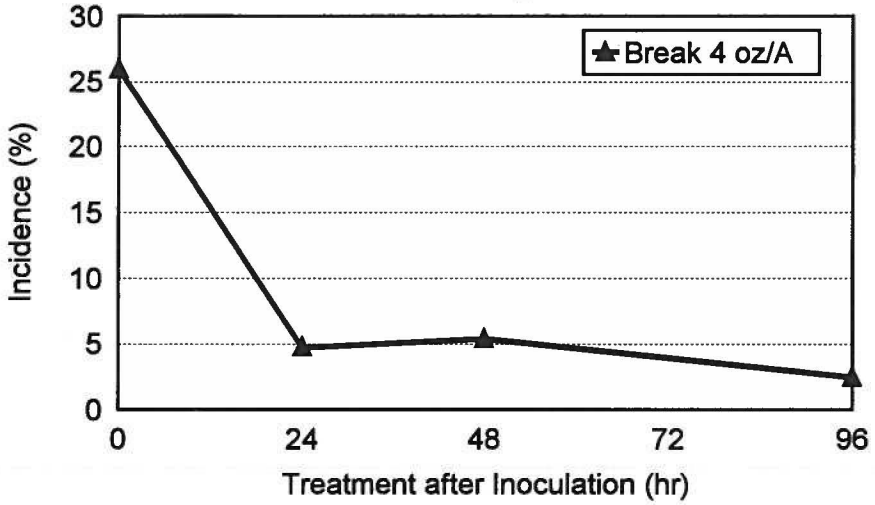
- Spring 1997 -



Treatments were applied using an air-blast, back pack sprayer calibrated for 100 gal/A. Disease incidence was determined based on a 200 spur sample per each of 4 single-tree replications.

Fig. 21. Efficacy of Break Applications after an Inoculation Period for Brown Rot Blossom Blight management on Drake Almond

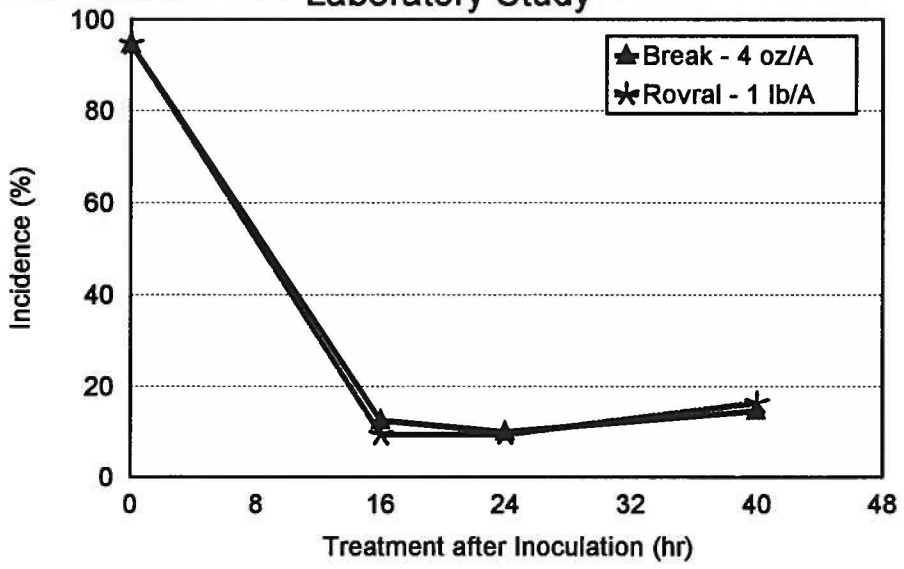
- Field Study -



Treatments were applied using an air-blast, back pack sprayer calibrated for 100 gal/A. Disease incidence was determined based on a 30 blossom sample per each of 4 single-tree replications.

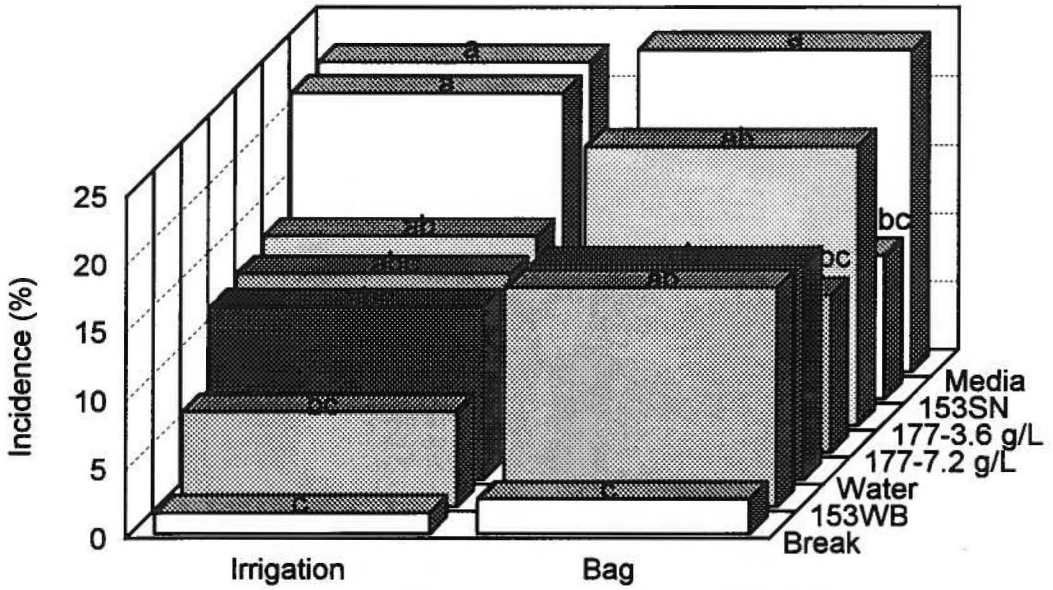
Fig. 22. Efficacy of Break or Rovral Applications after an Inoculation Period for Brown Rot Blossom Blight Management on Drake Almond

- Laboratory Study -



Treatments were applied using an air-blast, back pack sprayer calibrated for 100 gal/A. Disease incidence was determined based on a 30 blossom sample per each of 4 single-tree replications.

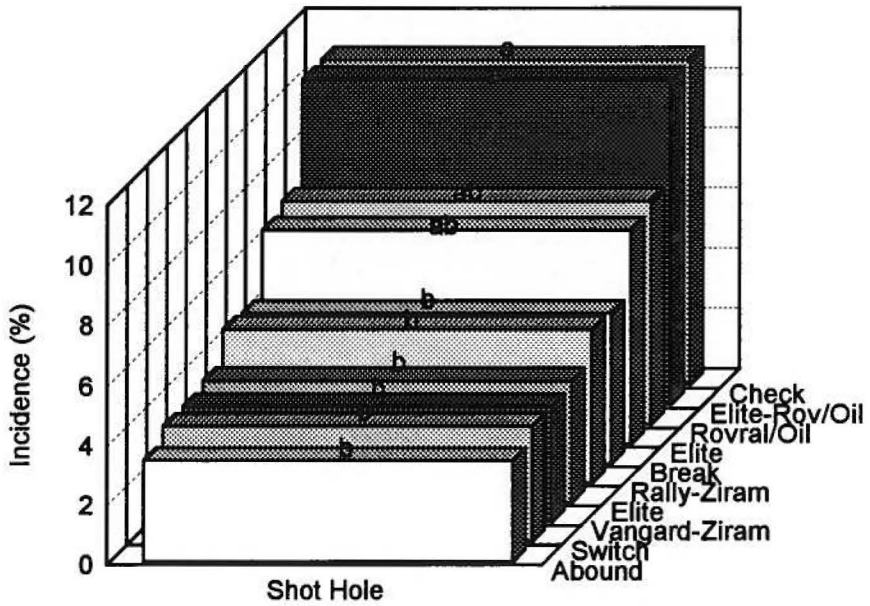
Fig. 23. Efficacy of Biocontrol Treatments for Brown Rot Blossom Blight Management of Drake Almond



Treatments were applied using an air-blast, back pack sprayer calibrated for 100 gal/A. Blossoms were inoculated with an aqueous suspension of conidia (25K/ml) of *M. laxa*. After inoculation, inoculated blossoms were bagged for 18 hrs or sprinkler irrigated for 8 hrs. After 10 days, disease incidence was determined based on a 30 blossoms inoculated for each of 4 single-tree replications.

Fig. 24. Efficacy of Fungicide Treatments for Management of Shot Hole of Almond

- Spring 1997 -



Treatments were applied using an air-blast, back pack sprayer calibrated for 100 gal/A. Disease incidence was determined based on a 50 fruit sample per each of 4 single-tree replications.