Control of brown rot and shot hole in almond: 2009 field trial

Christopher N. Janousek and W. Douglas Gubler

Department of Plant Pathology, University of California, Davis, CA 95616

University of California Cooperative Extension,
Department of Plant Pathology,
University of California, Davis - January 2010

Published January 2010 at: http://escholarship.org/uc/plantpath_ucd.

Introduction

California almonds are affected by a number of branch and foliar diseases including brown rot and shot hole (Ohlendorf and Strand 2002). Shot hole is a foliar and fruit disease caused by the fungal pathogen *Wilsonomyces carpophilus* (Gubler et al. 2009). Spores of the pathogen are transmitted by water to new infection sites and develop into lesions that eventually cause defoliation and losses in fruit yield (Highberg and Ogawa 1986, Gubler et al. 2009). Warmer temperatures and increasing periods of free moisture are positively associated with infection density (Shaw et al. 1990). Brown rot is usually caused by the fungal pathogen *Monilinia laxa*, which preferentially infects shoots via flowers when free water is available at bloom (Ohlendorf and Strand 2002). Following infection, blossoms will wither and the pathogen will spread into adjacent wood (Ohlendorf and Strand 2002).

Because of the dependence of both pathogens on rain for infection of host tissues, fungicide applications to control these diseases are linked to precipitation patterns during the season and thus may be variable in timing and frequency (Gubler et al. 2009). We evaluated two organic products (Regalia SC and JMS Stylet-oil) and a synthetic pesticide (Pristine) for management of shot hole and brown rot on almond (*Prunus dulcis* cv Peerless) in a field trial in northern California during early 2009.

Materials and Methods

The experiment was conducted at the University of California, Davis plant pathology farm in northeastern Solano County. Two rows of almond trees grafted to Marianna 2624 and Peach rootstocks were used; a single row of plum (cv Shiro) separated the almond trees. Treatments were applied to plots (individual trees) arranged in a completely randomized design with five replicates per treatment (each replicate consisted of 0.0052 acres). Fungicides were mixed in water in a 25 gallon Nifty Fifty sprayer and applied with a hand gun using 125 gallons of water per acre. Three applications were made during early 2009: 20 February (pink bud), 27 February (bloom/petal-fall), and 16 March (post-bloom).

Brown rot and shot hole symptoms were evaluated on 16 April 2009. Shot hole severity was estimated using a rank-based index (0-6) with a rank of 0 indicating disease-free trees and a rank of 6 indicating that trees were infected with ≥10 lesions per leaf. Shot hole data was statistically evaluated with a Kruskall-Wallis test in SAS v. 9.1.3. Brown rot severity was estimated by counting the number of blighted shoots per tree and evaluated statistically with one-factor ANOVA followed by Fisher's LSD means comparison test.

Table 1. Experimental treatments used to control brown rot and shot hole symptoms on Peerless almond. Application periods: P = pink bud; B = bloom; PB = post-bloom.

Fungicide treatment	Application periods	Application rate (acre^{-1})	Formulated product per 5 replicate trees
Water control	none	water only	water only
Regalia SC (extract of *Reynoutria sachilinensis*)	P, B, PB	1% (v/v)	121 ml
Pristine 38WDG (boscalid + pyraclostrobin)	P, B, PB	14.5 oz	10.6 g
Pristine alternated with Regalia	P, PB B	14.5 oz alternated with 1% (v/v)	10.6 g alternated with 121 ml
JMS Stylet-oil (paraffinic oil)	P, B, PB	2% (v/v)	242 ml

Results and discussion

Brown rot severity in trees treated with Pristine or Pristine alternated with Regalia reached no more than 50% of the level observed in the water-treated controls (Table 2). Regalia alone and JMS Stylet-oil had little effect on disease management. Fungicide effects on shot hole were also statistically significant ($\chi^2 = 21.0$, df = 2, $P < 0.001$), with both Pristine treatments giving the lowest disease severity. However, overall disease pressure was relatively light (Figure 1). Regalia alone did not effectively manage either disease, although a similar field trial in 2008 suggested that it was about as effective at managing brown rot symptoms as mixed programs of Regalia and Pristine (W.D. Gubler and H. Su, unpublished data). Both years of data suggest that biological fungicides might be successfully incorporated into synthetic treatment programs for almond disease management.

Figure 1. Shot hole symptoms on water-treated trees.

Table 2. Brown rot and shot hole severity in water and fungicide-treated trees. Letters accompanying brown rot severity data indicate significantly different groups of means according to Fisher's LSD test at $\alpha = 0.10$.

Fungicide treatment	Brown rot severity (mean ± 1SE)	Mean shot hole severity index (0-6 scale)
Water control	16.6 ± 2.7 b	1.8
Regalia, 1% (v/v)	19.8 ± 1.7 b	1.8
Pristine, 14.5 oz	6.2 ± 0.8 a	0.0
Pristine, 14.5 oz alt Regalia, 1% (v/v)	8.0 ± 1.0 a	0.2
JMS Stylet-oil, 2% (v/v)	20.8 ± 2.7 b	2.0

Acknowledgements

We thank Jerry Uyemoto for assistance. Funding for this research was provided by the IR-4 biofungicide program of the US EPA and USDA.

References

Gubler WD, Adaskaveg JE, Duncan R, Stapleton JJ and Holtz BA. 2009. Almond Shot Hole. UC IPM Online, University of California, Agriculture and Natural Resources publication 3431, available at http://www.ipm.ucdavis.edu/PMG/r3100211.html.

Highberg LM and Ogawa JM. 1986. Yield reduction in almond related to incidence of shot-hole disease. Plant Disease 70:825-828.

Ohlendorf BLP and Strand LL. 2002. *Integrated Pest Management for Almonds.* University of California, Agriculture and Natural Resources publication 3008.

Shaw DA, Adaskaveg JE and Ogawa JM. 1990. Influence of wetness period and temperature on infection and development of shot-hole disease of almond caused by *Wilsonomyces carpophilus*. Phytopathology 80:749-756.