Effect of fungicide treatments on incidence of powdery mildew of pecan and on pecan nut quality

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Abstract

Powdery mildew of pecan, caused by Microsphaera ulni, was observed on pecan shucks by the latter part of June 2000 in a commercial pecan orchard near Sahuarita, Arizona. Results of 1999 studies indicated that infection does not reduce nut quality. In order to determine effects of fungicide treatments and to substantiate results from 1999, preventive applications of micronized sulfur and azoxystrobin were initiated on June 8, 2000 in selected clusters in both Wichita and Western varieties. Trials were established in plots that had a high incidence of powdery mildew in 1999. Whole nut weights, kernel weights, or color ratings were not significantly different among clusters of nuts that were treated with fungicides and untreated nuts that were infected with powdery mildew. Percent disease incidence was 100% in untreated clusters, 0% in clusters treated with azoxystrobin every two weeks, and 5.3% (Wichita) and 8.8% (Western) in clusters treated with sulfur three times early in the season. Results indicate that disease did not affect nut weight or quality and that early preventive fungicide treatments are effective in controlling infections.

Introduction

Powdery mildew of pecan, caused by *Microsphaera* sp., occurs on pecans in the southeastern and southwestern United States. There is very little information on effects of disease on different varieties of pecan or on nut quality and yield. Bertrand (1982) reported that powdery mildew is common on nuts in Georgia, but studies have not shown a consistent relationship between severe powdery mildew and poor kernel development. Gottwald et al., 1984, found consistent but small effects of powdery mildew on kernel oil, protein, free fatty acids and moisture content, and negligible effects on net photosynthesis and dark respiration. Large and Cole, 1964, reported a reduction in number of nuts per pound when mildew was not controlled, but methods of comparison and statistical analysis were not given.

In the summers of 1998, 1999 and 2000, outbreaks of powdery mildew were observed throughout commercial pecan orchards in Sahuarita and Continental, Arizona. In both 1999 and 2000, the fungus had infected the green shucks of nuts on both Western and Wichita varieties by late June causing superficial lesions over much of the shuck surfaces. It continued to produce conidia sporadically throughout the summer. Infections were restricted to shucks and very young leaves, and were never observed on mature leaves. Initial infections were severe in areas of high humidity and shade, and many mature nuts appeared almost white during initial disease outbreak in late June and early July. Lesions later turned light brown.

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In 1999, studies comparing fungicide treated nuts, that remained symptomless, to untreated nuts, that were heavily infected, indicated that powdery mildew infections did not affect nut quality (Olsen et al., 2000). Studies were conducted in 2000 to determine the efficacy of fungicide treatments and to substantiate results of the 1999 experiments.

Materials and Methods

In June 2000, studies were initiated to determine the effect of preventive fungicide applications on incidence of powdery mildew and the effect of disease on pecan nut quality. Trials were established in two plots of pecans, one of Wichita variety and one of Western variety, that had been used for studies in 1999 and had a high incidence of disease. In early June, 10 trees with 10 to 13 groups of clusters and 12 trees with 4 to 20 groups of clusters in the Wichita and Western plots, respectively, were marked before disease appeared. Trees were chosen based on the number of clusters in the lower, inner canopy where they could be easily treated and disease was likely to be most severe. Groups of three clusters growing close together in the same environment (amount of shade, height on tree) were carefully chosen and marked as disease free. One cluster was treated with azoxystrobin (Abound) at 3.2 oz. a.i./A in 120 gal water, the second with micronized sulfur (Microthiol Special) at 4 lb a.i./A in 120 gal water, and the third was left as an untreated control. Azoxystrobin treated clusters were sprayed every two weeks from June 8 to September 8, 2000 and micronized sulfur treated clusters were treated three times, June 8, June 23 and July 7, 2000.

Clusters in both plots were harvested on October 31, 2000. Nuts were mature, and most shucks were partially green and beginning to open. Clusters contained from one to six nuts, and groups of clusters did not always have the same number of nuts. Numbers of clusters harvested and used for statistical analysis were 95 (Wichita, sulfur), 94 (Wichita, azoxystrobin), 107 (Wichita, control, 113 (Western, sulfur), 109 (Western, azoxystrobin) and 113 (Western, control) after losses due to mechanical damage. Clusters were stored at room temperature in paper bags until shucks were dry. All whole nuts and kernels in each cluster were individually weighed, and the average weights determined for each cluster. These weights were used to determine the average percent fill for each cluster.

Kernels of each nut were rated for development and color according to USDA 41 F. R. 39303, 1976. All edible nuts were rated for color on a scale of 1-4, with 1 = light or golden, 2 = light amber or light brown, 3 = amber or medium brown, and 4 = dark amber or dark brown. Color ratings were calculated for each cluster. Undeveloped nuts rated as inedible (very dark brown or black wafers and undeveloped nuts) were not used for color ratings and were considered “discarded”. The per cent “discarded” nuts was calculated using the number of individual nuts discarded divided by the total number of nuts in each treatment in each variety. Significance of treatments within variety on whole nut and kernel weights, percent fill, and color and between varieties (plots) on all measurements, with data combined within varieties, was determined using ANOVA in Excel.

Results and Discussion

At harvest, 100% of untreated clusters were infected with powdery mildew in both plots, none of the azoxystrobin treated clusters was infected in either plot, and 5.3% and 8.8% of the sulfur treated clusters in the Wichita and Western plots, respectively, were infected. Infections were first observed on untreated clusters in late June, and all of those included in the trial were infected by early July. Even though the fungus continued to sporulate sporadically throughout the summer, new lesions were not observed on any nuts in the study after the first week in July, indicating that only developing shucks are susceptible to disease. These observations were substantiated by the absence of new infections on sulfur treated clusters in both varieties after the July 8 treatment.

Whole nut weights, kernel weights and percent fill of diseased and healthy clusters within each variety were not significant between treatments (Table 1). When all weights were combined within a variety, the nut weight, kernel weights, and percent fill were significant between varieties (Table 3). Color ratings between kernels from diseased and healthy nuts within each variety were not significant between treatments (Table 2), but when combined, ratings within varieties were significant (Table 3). The percentage of kernels rated as inedible and considered “discarded”, and not rated for color, was not significant between varieties (Table 3).

Results of this study indicate that powdery mildew infection of pecan shucks did not affect nut quality. The weights of whole nuts, weights of kernels, percent fill, and color ratings were not significant between clusters that were infected and those that were healthy. The clusters used in this trial were located in the lower canopy of the tree where they could be reached from the ground. Because powdery mildew infections are more severe in shaded areas within the tree canopy (authors, personal observations), this data represents clusters in an environment with high disease pressure. Based on these results, fungicide applications for control of powdery mildew on shucks are not warranted.

Literature Cited

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Table 1. Average (std dev) weight of whole nuts, kernels and percent fill of pecans infected with powdery mildew (control) or treated with fungicides in two pecan varieties.

Plot/variety	treatment	nut weight (g)[1]	kernel weight (g)[1]	percent fill[1]
Wichita	sulfur	6.40 (1.08)	4.05 (0.80)	63.00 (3.38)
	azoxystrobin	6.17 (1.09)	3.96 (0.75)	62.80 (3.61)
	control	6.34 (1.07)	4.03 (0.77)	63.00 (4.03)
Western	sulfur	5.25 (1.04)	3.11 (0.76)	57.61 (5.14)
	azoxystrobin	5.15 (1.04)	3.08 (0.76)	58.10 (5.74)
	control	5.16 (1.01)	3.02 (0.77)	58.15 (5.06)

[1]Not significant among treatments within variety using ANOVA, P = 0.05.

Table 2. Average (std dev) rating per cluster of nut quality based on kernel color and average (std dev) percent total nuts discarded in two varieties of pecans infected with powdery mildew (control) or treated with fungicides.

Plot/variety	treatment	kernel color rating[1, 2]	percent total nuts discarded[1,3]
Wichita	sulfur	1.71 (0.38)	1.8
	azoxystrobin	1.70 (0.33)	1.8
	control	1.73 (0.38)	1.5
Western	sulfur	2.33 (0.46)	4.3
	azoxystrobin	2.32 (0.48)	4.3
	control	2.29 (0.50)	1.7

[1]Not significant among treatments within variety using ANOVA, P = 0.05.
[2]Rating of 1-4 with 1 = light or golden, 2 = light amber or light brown, 3 = amber or medium brown, and 4 = dark amber or dark brown.
[3]Inedible and undeveloped nuts not included in color rating.

Table 3. Average (std dev) whole nut weight, kernel weight, percent fill, kernel color and percent nuts discarded of combined treatments within varieties, and results of ANOVA between varieties.

Plot/variety	nut weight (g)	kernel weight (g)	percent fill	kernel color	percent nuts discarded
Wichita	6.30 (0.12)	4.01 (0.04)	62.93 (0.001)	1.7 (0.01)	1.7 (0.17)
Western	5.18 (0.05)	3.07 (0.05)	57.95 (0.003)	2.31 (0.02)	3.4 (1.5)
ANOVA P = 0.05	p = 0.0001	p < 0.0001	p < 0.0001	p <0.0001	p = 0.118