

Effect of powdery mildew on pecan nut weight and quality

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Abstract

*Powdery mildew of pecan, caused by *Microsphaera ulmi*, results in discoloration of pecan shucks, but its effects on yield and quality of kernels are not known. In 1999, powdery mildew was observed on pecan shucks by the latter part of June in a commercial pecan orchard near Sahuarita, Arizona. The fungus continued to be active throughout the summer. However, results of a field test comparing diseased and healthy nuts from two varieties of pecans indicate that powdery mildew did not affect nut weight or quality. Whole nut weights, kernel weights, color ratings or percentage of discarded nuts were not significant between paired clusters of nuts that were treated with fungicides and remained disease free and untreated nuts that were infected with powdery mildew. Although shucks may have a high percentage of area covered by powdery mildew, results from this trial indicate that fungicide treatments are not warranted.*

Introduction

Powdery mildew of pecan, caused by *Microsphaera ulmi* (also called *Microsphaera penicillata*) 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 and 1999, outbreaks of powdery mildew were observed throughout commercial pecan orchards in Sahuarita and Continental, Arizona. In 1999, 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 the shucks, and no mildew was found on leaves or other parts of the plant. Initial infections were severe in areas of high humidity and shade, and many mature nuts appeared almost white during initial disease outbreak. Lesions later turned light brown. Because of the widespread and sudden occurrence of disease, studies were initiated to determine if the infections affected the quality of nuts.

Materials and Methods

In June 1999, studies to compare nut quality in infected and non-infected nuts were initiated in two plots of pecans, one of Wichita variety and one of Western variety. In each plot, 10 pairs of clusters growing close together in the same environment (amount of shade, height on tree) on each of 10 trees were carefully chosen and marked as disease free. One cluster of each pair was treated with fungicide to prevent infection, and the other left untreated.

Fungicide treated clusters were sprayed every two weeks from June 26 to September 10, 1999 with azoxystrobin (3.2 oz. a.i./A) in sprays 1-3 and 5-6, and myclobutanil (2.4 oz. a.i./A) in spray 4.

Clusters in the Wichita and Western plots were harvested on October 20 and November 12, respectively, when nuts were mature, and most shucks were still green and just beginning to open. Clusters contained from one to five nuts and paired clusters did not always have the same number of nuts. Shucks were rated for percent coverage by powdery mildew using the method of Nutter in Alfalfa.Pro Software, which is a tutorial for determining the percent infection of foliar pathogens (Nutter). Pairs of clusters in which the untreated control had no disease symptoms were not used for data analysis.

After harvest, all clusters were stored at room temperature in paper bags until shucks were dry. All whole nuts and extracted kernels in each cluster were individually weighed, and the average weight of each cluster determined. These weights were used to determine percent fill. The kernels were rated for development and color according to USDA 41 F. R. 39303, 1976. Undeveloped nuts rated as inedible (very dark brown or black wafers and undeveloped nuts) were not used for color ratings and were considered “discarded”. 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, and the average color rating was calculated for each cluster. Significance of treatments within variety on weights, percent fill, and color were determined using t-Test: Paired Two Sample for Means in Excel; within variety on percentage of discarded nuts from each tree in each treatment using t-Test: Two-Sample Assuming Equal Variances; and between varieties (plots) on all measurements, with data combined within varieties, using ANOVA: Single Factor in Excel.

Results and Discussion

Originally, 100 clusters, 10 clusters on each of 10 trees, were paired in each plot. At harvest, 79 paired clusters remained in the Wichita variety and 72 in the Western variety. However, only those pairs in which the untreated clusters were infected with powdery mildew were used for data analysis (56 pairs in Wichita; 57 pairs in Western). Powdery mildew was never observed on nuts treated with fungicide, and these clusters were considered healthy. In non-treated clusters, percent coverage of the shucks by powdery mildew lesions ranged from 5 to 80% of each nut.

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 treatments within variety (Table 2) but was 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, color ratings and percentage of kernels discarded were not significant between clusters that were infected and those that were healthy. Clusters lost during the season were a result of mechanical damage either by entire limbs breaking or machinery.

The clusters chosen in this trial were by necessity in the lower canopy of the tree where they could be reached from the ground and may differ somewhat from those in the upper canopy. However, because powdery mildew infections are much more severe in shaded areas within the tree canopy (authors, personal observations), this data represents clusters in an environment with high disease pressure. Absence of any differences in nut quality between infected and healthy clusters used for these studies should therefore be viewed with confidence. 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 (non-treated) or healthy (treated) in two pecan varieties.

variety	treatment	nut weight (g) ¹	kernel weight (g) ¹	percent fill ¹
Wichita	infected	5.74 (0.98)	3.49 (0.70)	61 (3)
	healthy	5.68 (0.79)	3.47 (0.60)	61 (4)
Western	infected	3.80 (0.69)	1.97 (0.50)	51 (5)
	healthy	3.72 (0.77)	1.89 (0.52)	50 (6)

¹Not significant between treatments within variety using t-Test: Paired Two Sample for Means, 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 (non-treated) or healthy (treated).

variety	treatment	kernel color rating ^{1, 3}	percent total nuts discarded ^{2, 4}
Wichita	infected	2.76 (0.46)	1.7 (2.2)
	healthy	2.67 (0.43)	1.8 (4.1)
Western	infected	3.12 (0.81)	15.9 (16.6)
	healthy	3.18 (0.89)	19.0 (17.5)

¹Not significant between treatments within variety using t-Test: Paired Two Sample for Means, P = 0.05.

²Not significant between treatments within variety using t-Test: Two Sample Assuming Equal Variances, P = 0.05.

³Rating 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.

⁴Inedible 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.

variety	nut weight (g)	kernel weight (g)	percent fill	kernel color	percent nuts discarded
Wichita	5.71 (0.89)	3.48 (0.66)	61 (4)	2.71 (0.44)	1.7 (3.2)
Western	3.76 (0.73)	1.93 (0.51)	51 (6)	3.15 (0.85)	17.5 (16.7)
ANOVA	F = 326.6	F = 400.3	F = 420.1	F = 22.2	F = 17.3
p = 0.05	p = 0.0000	p = 0.0000	p = 0.0000	p = 0.0000	p = 0.0002