

Commercial Pecans

Controlling Rosette, Diseases and Zinc Deficiency

Jerral D. Johnson and George Ray McEachern*

Health and vigor of pecan trees plus satisfactory nut quality and yield depend on a well-planned and executed disease management program. Losses from diseases and insufficient zinc nutrition can be prevented by following effective grove management practices.

Disease Development

Spring and Early Summer

The fungi that cause pecan diseases require moisture and mild temperatures during spore germination and infection of the immature leaves and nutlets. Losses to disease-causing pathogens are reduced by following cultural practices that shorten the length of time leaves and young nutlets are wet following

rain, dew or irrigation. In addition to weather condition problems, the leaves and nutlets are immature and are most susceptible to the pecan scab fungus during this period. Foliage of susceptible cultivars is susceptible to downy spot fungus during this period. Although cultural practices are followed, a protective fungicide is required in some locations and on scab-susceptible cultivars. Continue applications on a 14-day interval as long as weather conditions favor infection.

Mid Summer

During the summer months, occurrence of rain and dew is less likely to occur for extended periods of time. This reduces the chance of infection. Producers who carefully monitor weather conditions and disease development can reduce fungicide costs by reducing rates and increasing intervals between applications.

Late Summer and Early Fall

Producers must continue to monitor weather conditions during the late summer and early fall months. Foliage is mature and no longer susceptible to the scab fungus, but shucks surrounding the nuts are immature and susceptible to late season infection.

Factors that Influence Disease Development

Producers should consider the following factors as they develop a spray program:

- Susceptibility of variety to pecan diseases, especially pecan scab,
- Current weather conditions,
- Predicted weather conditions for next 1 to 2 weeks,

*Associate Department Head, Professor and Extension Program Leader for Plant Pathology; Professor and Extension Horticulturist (Pecans and Grapes).

- Status of disease pressure in and near the orchard,
- Tree spacing,
- Age of trees,
- Past history of disease in the orchard,
- Date of last fungicide applications and
- Last fungicide applied.

Periods When Pecan Diseases Are Most Often Observed

Producing high quality pecans that are both appealing and disease free requires multiple sprays during the growing season in most locations. Table 1 specifies periods when pecan diseases are most often observed and when zinc can be used effectively.

Nut Development or Insect Occurrence	Diseases Most Likely to Occur at This Stage	Stages When Trees Best Respond to Zinc
Bud break	Scab, Downy Spot	Rosette (Zinc Deficiency)
Prepollination	Scab, Downy Spot, Vein Spot	Rosette
Casebearer	Scab, Downy Spot, Vein Spot	Rosette
1st Cover (14 days after Casebearer)	Scab, Fungal Leaf Scorch	Rosette
Cover Sprays (continue at 14-21 days as long as weather conditions favor disease development)	Scab, Brown Leaf Spot, Fungal Leaf Spot, Powdery Mildew	
Water Stage	Scab, Stem End Blight	
Shuck Worm	Scab	

¹The exact time for fungicide applications varies. Fungicide applied, varieties, current and predicted weather conditions, and disease pressure all influence the number and timing of fungicide applications. Rosette treatments are effective only on immature foliage. All foliage is mature on mature trees by mid June. On young trees the foliage is receptive to zinc during the entire growing season.

Table 2 gives information on suggested fungicides which have

been approved for use on pecans.

Table 2. Fungicides Approved for Use on Pecans and Diseases They Are Reported to Control.

Fungicide	Rate/A	Pecan Scab	Downy Spot	Brown Leaf Spot	Powdery Mildew	Liver Spot	Fungal Leaf Scorch
Benlate™ 50 WP	8-16 oz	+	+	+	+	+	+
Topsin™ M 70 WP	8-16 oz	+	+	+	+	-	-
Orbit™ 45 WP Super Tin™ 80WP Co-pak*	20 oz/5A 25 oz/5A	+	+	+	-	+	+
Enable™ 2F	8 fl. oz	+	+	-	-	-	+
Super Tin™ 80WP	5-7.5 oz	+	+	+	+	+	-
Ziram™ 76 WP	0.5-1.0 lb	+	-	-	-	-	-
Basicop™	2 lb/100 gal	+	-	-	-	-	-
Abound™	9.2-12.3 oz	+	-	-	-	-	-

*Orbit™ and /Super Tin™ are packaged in separate water soluble bags. One bag of each is required to spray 5 acres.

Fungicide Activity

Fungicides differ in how they act on fungi. Fungicides that act on the fungus on the surface of the leaf or nutlet are contact materials. Disease development is affected when spores of the fungus are exposed to the fungicide on the surface of the plant tissue.

Systemic fungicides are taken in by the plant and become part of the sprayed tissue. These fungicides must retain their activity even after they are taken in by the tissue. With fungicides used

on pecans, the movement of the fungicide is restricted. They do not move freely throughout the tree. The fungus is exposed to the fungicide both on the surface of the tissue and below the epidermal cells (Table 3).

Some systemic fungicides have the ability to act on the pathogen even after it has penetrated the leaf and started to develop outward. This is known as "kick back." The length of time after infection that the fungicide will still control the pathogen varies with fungicides but is normally from 24 to 72 hours.

Label Restrictions Control Use of Some Fungicides

Although all the products listed are approved for use on pecans, label restrictions and environmental concerns may restrict their use. These must be considered when selecting products. Always read the label and follow it closely (Tables 4 and 5).

Table 3. Mode of Action for Fungicides Approved for Use on Pecans.

Systemic Fungicides

Benlate™	Orbit™ 45WP/Super Tin™ 80W/Co-pack
Topsin M™	Enable™
Abound™	

Contact Fungicides

Super Tin™	Ziram™	Basicop™
------------	--------	----------

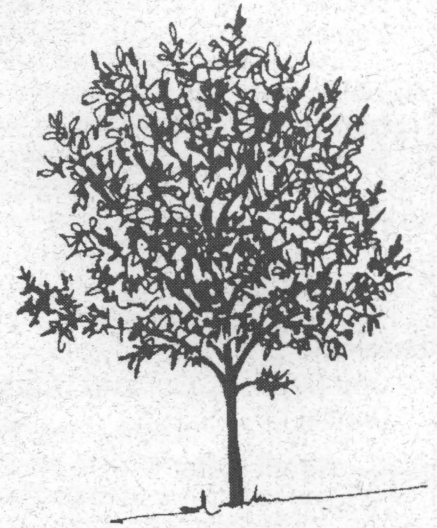


Table 4. Considerations When Selecting Fungicides.

Suggested Fungicides to Use Around Homes and Urban Developments

Benlate™
Topsin M™

Fungicides to Use Where Cattle Will Be Grazed in the Next 12 Months

Benlate™ Basicop™
Ziram™

Fungicide to Use in Organic Program

Basicop™

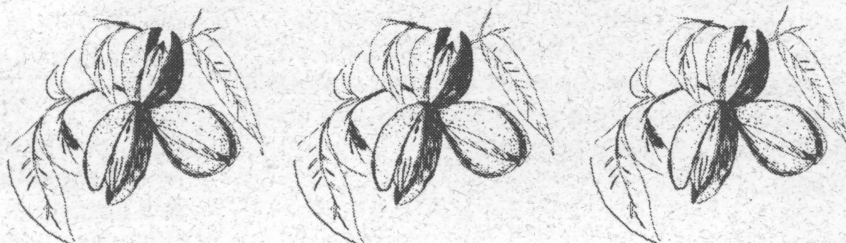


Table 5. Comparison of Toxicity of Approved Fungicides.

Fungicide	Toxicity*
Benlate™	
Oral LD ₅₀	>10,000 mg/kg
Dermal LD ₅₀	>10,000 mg/kg
Topsin M™	
Oral LD ₅₀	>5,000 mg/kg
Dermal LD ₅₀	>10,000 mg/kg
Abound™	
Oral LD ₅₀	>5,000 mg/kg
Dermal LD ₅₀	>2,000 mg/kg
Enable™	
Oral LD ₅₀	>2,000 mg/kg
Dermal LD ₅₀	>5,000 mg/kg
Ziram™	
Oral LD ₅₀	1,539 mg/kg
Dermal LD ₅₀	>2,000 mg/kg
Orbit™	
Oral LD ₅₀	1,310 mg/kg
Dermal LD ₅₀	5,000 mg/kg
Basicop™	
Oral LD ₅₀	1,000 mg/kg
Dermal LD ₅₀	>8,000 mg/kg
Super Tin™	
Oral LD ₅₀	156 mg/kg
Dermal LD ₅₀	1,600 mg/kg

*LD₅₀ = A measure of pesticide toxicity. The lower the LD₅₀, the greater the toxicity. Oral is ingested. Dermal is skin exposure.

Fungicide Resistance Management

To avoid the possibility of developing strains of pecan scab fungus that are resistant to a specific fungicide chemistry, a rotation of different fungicides should be followed during the season. Table 6 outlines possible fungicide rota-

tions. Tank mixing two types of fungicides can reduce the chance of fungicide resistant strains. The disadvantage of this method is that it can increase fungicide costs. Repeated use of systemic fungicides of the same type increases the possibility of fungicide resistant strains developing. When alternating fungicides, use the most effective materials during periods of greatest disease pressure.

Table 6. Possible Fungicide Rotations to Avoid Fungicide Resistance.

Fungicides	Rotate With
Benzimidazole Type	
Benlate™ Topsin™ M	Orbit™ Enable™ Super Tin™ Abound™ Ziram™ Basicop™
Triazole Type	
Enable™	Super Tin™ Benlate™ Topsin M™ Abound™ Ziram™ Basicop™

Although Orbit™ is a triazole type fungicide, the new Co-pak with Super Tin™ should prevent or delay development of resistant strains of the scab fungus.

Management of Pecan Diseases Using Basicop™ (Copper Sulfate Type Fungicide)

Copper sulfate fungicides are considered by many to be organic pesticides. Basicop™ is a formulation of copper sulfate and is approved by the Environmental Protection Agency for use on pecans. Although approved for use on pecans, Basicop™ is not as effective as some of the other fungicides for the control of the pecan scab fungus. Apply only to natives or varieties that have a high level of resistance to the scab fungus or during periods of low disease pressure. Use caution when using copper type

fungicides. Drift onto fruit trees such as peaches, plums, nectarines and apricots can cause severe leaf and fruit shed. Be sure to clean up equipment after using copper materials. Copper is corrosive to equipment if not handled properly.

Zinc Nutrition

Pecans require zinc for normal stem and leaf growth. Trees not receiving zinc do not produce sufficient indoleacetic acid. Indoleacetic acid (IAA) is a naturally occurring growth hormone responsible for shoot elongation, leaf development and other critical plant functions. Internodes between the leaves and stems are shortened.

This compaction of the annual growth is known as zinc rosette. Leaves are smaller, thickened and somewhat distorted. When severe, affected leaves develop necrotic areas between the veins. Fungi are often associated with the necrotic lesions.

Zinc sprays are essential for early season pecan growth. Early, frequent applications are the most effective. Several formulations of zinc are approved for use on pecans. Elemental zinc is the most toxic to plants other than pecans and grapes. Avoid drift to protect nearby plants from phytotoxicity. If drift is a possibility, use NZN™ or a similar formulation. Do not use any zinc product at higher than the labeled rate. If applying more than one zinc spray within 2 weeks, reduce the rate by one-half. Never spray young trees that are not actively growing.

Table 7. Zinc Sources and Rate/100 Gallons of Water.

Source	Rate/100 Gallons of Spray Solution
Zinc Sulfate™ (36% WP)	2 lb
Zinc Nitrate™ (17% L)	20 fl oz
Tracite-N-Zinc™ (17% L)	1 qt
NZN™ (6% L)	1 qt
ZN Special™ (13.5% WP)	2 lbs

Aerial Application of Fungicides

Aerial application of fungicides either by fixed wing or rotary aircraft has not proven as effective as ground applications. During periods of unfavorable weather conditions that prevent use of ground equipment, it may be necessary to make an aerial application if disease potential is severe. Tree height, density of leaf canopy and requirements for maximum coverage must be considered to achieve satisfactory disease control.

Chemical Use Precautions

Select suggested materials for most effective, safe, economical control. All suggested materials are poisonous, but proper handling reduces the hazards associated with use. Read and comply with manufacturers' label directions for storage and handling of toxic chemicals.

Residues

The EPA has established pesticide residue tolerances on pecans. These regulations establish the amount of a specific chemical that can be present in or on pecans at harvest. Always consult the product label for specific restrictions, and be sure the pesticide used is registered for use on pecans and is used only in accordance with specific application instructions.

Caution

All pesticides are poisonous; some are poisonous to man, animals, nontarget crops, etc. They should be used with caution and stored out of reach of children, irresponsible persons, livestock and household pets. Properly dispose of leftover spray solution and empty containers.

Pesticide Drift

Avoid spray drift into urban areas, rivers or lakes, or crops that will be used for food for human consumption or livestock feed unless the product is approved for use on that crop and the rate and timing follow label recommendations.

Steps to Reduce Spray Drift

1. If an air blast sprayer is used, the force of the air blast should be directed away from the two or three rows next to a sensitive area.
2. Avoid spraying when the wind is blowing in the direction of a sensitive area.
3. Use caution when spraying toward county or state highways. Drift onto vehicles traveling the road can cause accidental exposure and concern.
4. Do not spray during periods of fog. Pesticides can be carried in the droplets for some distance from the application site.
5. When spraying around sensitive areas, use the least toxic materials.
6. Buffer zones can be used to prevent drift onto sensitive areas. A buffer zone can be an open space where native or planted grass can be used to catch drift. A dense grass buffer between the sprayed trees and surface water can filter out much of the pesticide runoff from pecan trees. Hedge rows or closely planted trees that do not require spraying can reduce drift. Research has shown that in some instances the drift will be carried by air currents over the plant material.

7. Cut off sprayer when there are open spaces between trees.
8. Make sure that the upper $\frac{2}{3}$ of the nozzles are directed to the upper 70 percent of the top canopy, but do not go above the tree.
9. Smaller droplets are more likely drift.
10. If there is a drift problem, stop and consider precautions to avoid movement of pesticides into sensitive areas.

Symptoms of Poisoning

Some symptoms of pesticide poisoning are headaches, nausea, cramps, blurred vision, weakness, muscular twitching and diarrhea. If any of these symptoms occurs during or following the handling of a pesticide or spraying, consult a physician immediately.

Always maintain a copy of the label and the Material Data Sheet.

Spray Application Considerations

Complete coverage of the foliage and nuts is essential. With conventional, high-volume hydraulic sprayers, $\frac{1}{2}$ to 1 gallon of spray mixture per foot of tree height is a general rule for the volume of finished spray required.

Most high volume sprayers require a pressure of 300 to 400 pounds per square inch. Low volume sprayers (mist blowers, air blast sprayers, speed sprayers, etc.) use forced air as the carrier to deliver a concentrated

spray mix and require proportionately less water. Concentrated spraying saves water and time but not pesticides since the same amount of pesticide is needed for each tree to obtain control.

Coverage

Thorough coverage of the pecan foliage and nuts with spray solution is necessary. The fungi that affect pecans infect the tissue where they land on the leaf or shuck. Coverage is important for both contact and systemic fungicides.

Calibration

Calibrate sprayers before making any pesticide application. This is necessary to determine the amount of chemical to add to the spray tank. One of the easiest methods of determining the amount of water being applied per acre is to spray 0.5/A with clear water. Record the amount of water required to refill the tank. Multiply this amount by 2 and this is the amount applied per acre. Table 1 lists the number of trees per acre at different spacing and the number of trees in 0.5/A.

If an orchard is not planted in a row but is randomly spaced, determine the acres of land involved and the number of trees being sprayed. Divide the number of trees into the acreage and this is the average number of trees per acre. It will not be exact but will give an approximate number. If trees vary in size, spray representatives of each tree size when determining the amount of water being applied. This is the amount of water used to spray one-half acre of trees. Multiply this by 2 and this is amount of water used per acre.

Table 8. Tree Spacing and Number of Trees Per Acre.

Spacing	No. Trees/A	No. Trees/0.5 A
35X35	35	17.5
35X40	31	15.5
40X40	27	13.5
45X40	24	12.0
45X45	22	11.0
50X50	17	8.5
60X60	12	6.0

Using this rate and the rate of chemical per acre, the amount of pesticide applied per 100 gal-

lons of water can be determined. Below are two examples.

Example:**A. Tree spacing: 35X35**

Sprayer tank capacity: 300 gal

Fungicide rate/A: Enable™ 8 oz/A

Water required to spray 0.5 A: 85 gal

Water required to spray 1 A: $85(\text{gal}/0.5\text{A}) \times 2 = 170 \text{ gal/A}$

No. of acres covered with full tank of spray:

$300 (\text{tank capacity}) / 170 \text{ gal to spray } 1\text{A} = 1.8\text{A}$

Amount of fungicide needed to charge tank:

$8 \text{ oz/A} \times 1.8 \text{ A} = 14.4 \text{ oz}/300 \text{ gal tank}$

B. Tree Spacing: 60X60

Sprayer tank capacity: 300 gal

Fungicide rate/A: Benlate™ 2 lb

Water required to spray 0.5 A: 200 gal

Water required to spray 1 A: $200(\text{gal}/0.5\text{A}) \times 2 = 400 \text{ gal/A}$

No. of acres covered with full tank of spray:

$300 (\text{tank capacity}) / 400 (\text{gal/A}) = 0.75 \text{ A}$

Amount of fungicide needed to charge tank:

$2(\text{lb/A}) \times 0.75 \text{ A} = 1.5 \text{ lb}/300 \text{ gal tank}$

Summary of Pecan Disease and Zinc Management Program

Effective disease management programs require producers to utilize a wide variety of practices. Use the following practices in the control of pecan disease problems:

1. Select varieties that are productive and resistant to pecan scab fungus.
2. Select orchard sites that have good air circulation.
3. Tree spacing should allow for air circulation and sunlight. At midday, 25 percent of the orchard floor should be in sunlight.
4. Manage orchard floor to remove diseased shucks and leaves.
5. Apply zinc as a foliar spray.
6. Take soil samples and follow fertilizer recommendations.
7. Remove trees that are susceptible to pecan scab and cannot be properly sprayed.
8. Apply insecticides when pest populations reach levels that require treatment. (Refer to current Extension publications that have pest thresholds.)
9. Apply fungicides as needed.



Suggested pesticides are registered and labeled for use by the Environmental Protection Agency and the Texas Department of Agriculture. The status of pesticide label clearances is subject to change, and many may have changed since this publication was printed. County Extension agents and appropriate specialists are advised of changes as they occur.

The USER always is responsible for the effects of pesticide residues on livestock and crops, as well as problems that arise from drift or movement of the pesticide from one's property to that of others.

ALWAYS READ AND CAREFULLY FOLLOW THE INSTRUCTIONS ON THE CONTAINER LABEL.

For further information, contact your county Extension agent.

The information given herein is for educational purposes only. Reference to commercial products or trade names is made with the understanding that no discrimination is intended and no endorsement by the Cooperative Extension Service is implied.

Produced by Agricultural Communications, The Texas A&M University System

Educational programs of the Texas Agricultural Extension Service are open to all people without regard to race, color, sex, disability, religion, age or national origin.

Issued in furtherance of Cooperative Extension Work in Agriculture and Home Economics, Acts of Congress of May 8, 1914, as amended, and June 20, 1914, in cooperation with the United States Department of Agriculture. Zerle L. Carpenter, Director, Texas Agricultural Extension Service, The Texas A&M University System.

10M copies—New

PP,HORT