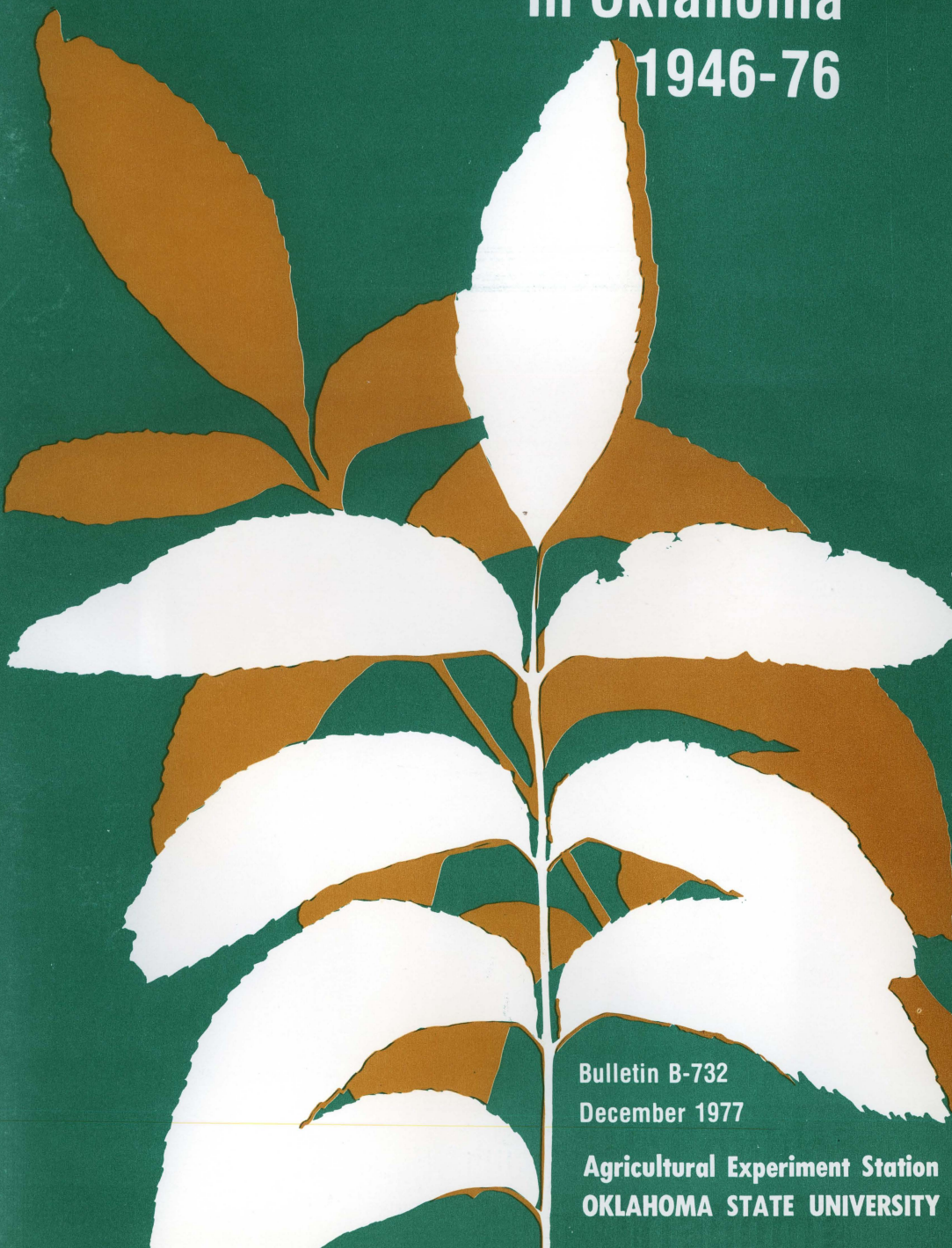


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Pecan Scab Control In Oklahoma 1946-76



Bulletin B-732
December 1977

Agricultural Experiment Station
OKLAHOMA STATE UNIVERSITY

Contents

Suggested Fungicide Formulations for Scab Control	
Introduction	1
Fungicide Tests	2
1946-1952 Period	2
1953-1957 Period	5
1958-1976 Period	7
1958 Season	8
1959 Season	8
1960, 1961 and 1962 Seasons	9
1963 Season	10
1964 and 1965	11
1966 Season	13
1967 Season	14
1968 Season	15
1969 Season	16
1970 Season	17
1971 Season	18
1972 Season	18
1973 Season	20
1974 Season	21
1975 Season	23
1976 Season	25
Conclusions and Use Suggestions	26
Literature Cited	26

Suggested Fungicide Formulations For Scab Control

Trade name	Active ingredient	Rate/100 gallons of spray mix
Cyprex 65W	65%	8 oz.
Du-Ter	47.5% triphenyl tin hydroxide	8 oz.
Benlate 50 WP	50% benomyl	8 oz.

Fungicides do not need to be used during long dry periods.

When very rainy periods or long dew periods occur, the trees should be sprayed every 14 days except for Benlate which need be applied only every 4 weeks.

Start spraying early in May and end in early September.

To prevent development of Benlate-resistant strains of the scab fungus, alternate applications of Benlate with another fungicide.

NOTE:

None of the suggested materials should be used where meat or dairy animals will be grazing.

The suggested materials are compatible with wettable powder formulations of suggested insecticides.

If a liquid formulation of an insecticide is to be used, first determine if it is compatible with the fungicide.

Do not breathe dusts or spray mists or droplets. Use proper protective clothing, gloves and masks.

Mention in this publication of a trademark name or a proprietary product does not constitute a guarantee or warranty of the product by the Oklahoma Agricultural Experiment Station and does not imply its approval to the exclusion of other products that also may be suitable.

Pecan Scab Control In Oklahoma, 1946-1976

George L. Barnes

Department of Plant Pathology

Pecan scab, caused by the fungus, *Fusicladium effusum* (43), is a limiting factor in the production of pecans throughout most of the pecan belt of the United States. Scab causes considerable loss of nuts and foliage from unsprayed trees of susceptible cultivars (varieties). Infection by spores of the fungus occurs during periods when rains and dew periods are frequent.

Primary infections first appear as olive brown to black pin point lesions on the nuts or on the veins on the undersides of leaflets. The pin point lesions enlarge and may coalesce. Later, with the occurrence of secondary lesions resulting from infections caused by spores produced on the primary lesions, large areas of the leaflets or nuts may be blackened (Figure 1). On nuts, lesions frequently become sunken causing malformations and nuts of highly susceptible cultivars may become black and drop prematurely. Infected nuts that don't drop are usually of poor quality and may be unmarketable.

Because the fungus overwinters in diseased nut shucks and twigs, it is necessary to follow a spray program each season and an effective spraying program is required for commercial production of nuts from scab-susceptible trees during most seasons. Effective scab control programs have been developed through many years of research with promising new fungicidal materials.

Most of the screening research in Oklahoma with new fungicidal formulations was conducted by Dr. G. L. Barnes. Other testing was done by Dr. R. H. Converse, H. A. Hinrichs and Dr. W. W. Ray. All materials tested are presented in Table 1.

Though various requirements varied the research program in Oklahoma from year to year, some procedures were usually very similar. Depending on the age of trees (and corresponding size), 25 to 35 gallons of spray mix were

Research reported herein was partially supported By Oklahoma Agricultural Experiment Station Projects S-806 and S-1286 and by grants provided by certain agricultural chemical companies.

*This publication terminates the research work on pecan scab control being done at this experiment station. Information published in Bulletin B-710, October 1973, has been combined with data gathered the past four years and is presented here as a complete report.



Figure 1.—Pecan scab lesions on nuts of the Burkett cultivar.

applied to individual trees at each spraying date. Frequency of application varied with the type of experiment and usually 6-10 trees per treatment were used. Appropriate insecticides were applied at recommended times and rates for insect control. Hydraulic spray machines were used in the early work but a speed sprayer (John Bean 703 CP) was used since 1963.

This publication reports results of 31 years of research on pecan scab control in Oklahoma and describes the fungicidal materials used, the test results, and the spray programs and sanitary practices currently suggested to achieve control of scab and some other diseases of pecans.

Fungicide Tests

1946-1952 PERIOD

Various fungicidal sprays and dusts were first applied to pecan trees for control of pecan scab in the humid southeastern United States during 1909 by Waite (52). Bordeaux mixture (reaction products of copper sulfate and hydrated lime in water) (45) was found, in early tests, to be very effective though somewhat phytotoxic (29). A reduction in the amount of lime used in preparation of the mixture was found to prevent injury (19). Even though it has several

Table 1. Commercial and experimental eradicator, protectant and systemic fungicides used in pecan scab control tests at Paden or Stillwater, Oklahoma, 1946-1976.

Trade name	Coined name and percent active ingredient	Manufacturer (abbreviated name)
Corona CM220	80% monocalcium arsenite	Pittsburgh Plant Glass
Elgetol	19% sodium dinitroorthocresolate, 5% sodium butylnaphthalene sulfonate, and 2% sodium chromate	Standard Agr. Chem. Co.
Dormant Fungicide	37% sodium pentachlorophenate and 5.5% sodium salts of other chlorophenols	United Chem. Co.
Bordeaux mixture	Reaction products of copper sulfate and hydrated lime in water	Prepared on farm
Zerlate	76% ziram (zinc dimethyldithiocarbamate)	duPont
Niacide Z	59.8% ziram plus 5.2% mercaptobenzothiazole	FMC
0-38188	2.8 parts zineb + 1.0 part NiCl · 4H ₂ O	Rohm & Haas
Fermate	76% ferbam (ferric dimethyldithiocarbamate)	duPont
Dithane Z-78	6% zineb (zinc ethylenebis dithiocarbamate)	Rohm & Haas
Parzate	65% zineb (zinc ethylenebis dithiocarbamate)	duPont
Parzate C	76%	duPont
Manzate	70% maneb (manganese ethylenebis dithiocarbamate)	duPont
Thylate	65% thiram (tetramethylthiuram disulfide)	duPont
Thioneb	50% polyethylene thiuram disulfide	U.S. Rubber
Phaltan	50% folpet (N-trichloromethyl thiophthalimide)	Chevron
Dyrene 50WP	50% 2, 4-dichloro-6-(o-chloro-anilino) triazine	Chemagro
Cyprex 65WP	65% dodine (n-dodecyl guanidine acetate)	Amer. Cyanamid
Amobam	41% diammonium ethylene bis dithiocarbamate	Roberts Chemicals
Dibam A	41.7% ammonium dimethyl dithiocarbamate	Roberts Chemicals
Dithane M-45	80% coordination product of manganese ethylene bis dithiocarbamate (maneb) and zinc ions	Rohm & Haas
Manzate D	80% maneb plus a zinc salt	duPont
TC-90	48% copper salts of fatty and rosin acids	Tenn. Corp.

Table 1. (Continued)

Trade name	Coloed name and percent active ingredient	Manufacturer (abbreviated name)
OMCC-1763	50% 2-chloroacetaldehyde (2,4-dinitrophenyl) hydrazone	Olin Mathieson
OC-2466	50% mucochloric anhydride	Allied Chem.
Polyram 80WP	80% of 5.2 parts by weight (83.9%) of ammoniates of ethylene bis (dithiocarbamate) zinc with 1 part by weight (16.1%) of ethylene bis (dithiocarbamic acid) bimolecular and trimolecular cyclic anhydrosulfides and disulfides	FMC
Du-Ter 20W	20% TPTH (triphenyl tin hydroxide)	Thompson-Haywood
Du-Ter	47.5% TPTH (triphenyl tin hydroxide)	Thompson-Haywood
Brestan 60	50-54% triphenyl tin acetate plus 20% maneb	Amer. Hoechst
Kocide 101	87% cupric hydroxide	Kennecott
Manzate 200	80% coordination product of zinc and manganese, ethylene bis-dithiocarbamate	duPont
Difolatan	80% captafol (cis-N-(1,1,2,2-tetrachloroethyl thio-4-cyclohexene-1-2-dicarboximide)	Chevron
Difolatan 4F	39% captafol (cis-N-(1,1,2,2-tetrachloroethyl thio-4-cyclohexene-1-2-dicarboximide)	Chevron
F-1991	50% benomyl (methyl 1-(butylcarbamyol)-2-benzimidazole carbamate)	duPont
Benlate	50% benomyl (methyl 1-(butylcarbamyol)-2-benzimidazole carbamate)	duPont
Cyprex 80W	80% dodine (n-dodecyl guanidine acetate)	Amer. Cyanamid
EL-273	10% a-(2,4-dichlorophenyl)-a-phenyl-5-pyrimidinemethanol	Elanco
Topsin M	70% dimethyl 4,4'-o-phenylene bis (3-thioallophanate)	Pennwalt
Bravo 6F	54% chlorothalonil (tetrachloroisophthalonitril) (6 lbs/gal)	Shamrock
CELA W-524	20% triforine (N, N'-(1,4-piperazinediyl bis (2,2,2-trichloroethylidene) bis [formamide])	FMC
Copper Count N	Ammoniacal copper from copper ammonium carbonate, 8% Cu	Mineral Res. & Dev.
RP-26019	50% 1-isopropylcarbamyol-3 (-3,5-dichlorophenyl) hydantoin	Rhodia
Kasumin	2% kasugamycin	Hokko Chem. (via Pennwalt)

disadvantages, Bordeaux mixture is still included on lists of suggested materials in the southeast.

In the southwestern pecan areas, Bordeaux mixture was first tested in Texas during the early 1940's (47). Ray (46) tested it in Oklahoma during 1945 and 1946 and found it effective. Ray's results were confirmed by Hinrichs (34, 35) and Hinrichs and Bieberdorf (38, 39) during the 1946, 1947, and 1948 seasons in Oklahoma. It was found in Texas that even low-lime Bordeaux mixture sometimes injured pecan leaves and nuts during very hot, dry weather and increased aphid populations (47). In addition, preparation of Bordeaux mixture is time consuming and sometimes messy. A more suitable fungicide was needed for control of pecan scab.

Beginning in the late 1940's many new fungicidal compounds were synthesized by chemists in various industrial firms and several of the more promising ones were evaluated for pecan scab control by a number of investigators. Hinrichs and Bieberdorf (39) reported successful control of scab in Oklahoma with ziram¹ during the 1947 season. Earlier, Cole (18) had demonstrated the effectiveness of ziram for scab control in Louisiana and Georgia during the 1946 and 1947 seasons, respectively. During 1948, Cole (19) reported that ferbam was not as effective as Bordeaux mixture during the 1942, 1943, and 1946 seasons in Georgia.

The first testing of ferbam for scab control in Oklahoma was made by Hinrichs (35) in 1949, but it was not as effective as ziram or Bordeaux mixture. In the same test, a formulation of zineb (Parzate) provided poor control, and ziram in another test during the same season, but under very wet conditions, was ineffective. During 1950, Rosberg (47) in Texas found that another zineb formulation (Dithane Z-78) provided control equivalent to that provided by Bordeaux mixture and provided better control than that given by either ferbam or ziram. Differences in formulation between the two zineb products at the time may have accounted for the failure of one of them to provide control in the Oklahoma test by Hinrichs. Both formulations have provided excellent control in many subsequent tests by investigators in several states, and were subsequently suggested for grower use. Rosberg (47) also noted that smaller aphid populations developed in zineb-sprayed trees than on Bordeaux-sprayed trees.

1953-1957 PERIOD

Many new fungicide formulations were tested during the 1953-1957 period by R. H. Converse for efficacy as eradicant (contact) or protectant materials for control of pecan scab. All test materials were applied with a single nozzle spray gun operated from a conventional hydraulic spray machine

¹Coined names, trades names and manufacturers of all commercial fungicides mentioned in this report are presented in Table 1.

operated at 600-800 psi.

F. effusum survives the winter months in masses of thick walled cells (stroma) formed in lesions on twigs, nut shucks and leaflets. During the spring, spores are abundantly produced on the stroma. Several workers have investigated the possibility of control of pecan scab by attempting to kill the stroma by application of eradicant materials during the dormant period. Converse (24) reviewed the work through 1953.

The results from the early trials with Bordeaux mixture, lime sulfur and dinitrophenolic compounds indicated that even though they killed the sprayed stromata in the trees they did not prevent development of scab during the growing season. Stromata on fallen nut shucks and twigs on the orchard floor produced sufficient spores to initiate the disease cycle. Other workers used eradicants during the dormant season plus a reduced summer protectant program but did not achieve control any better than that provided by a full summer protectant program. Additional eradicant type materials were evaluated by Converse (25, 26) during the 1953-57 seasons with comparable results (Table 2). Graves (32) had comparable results in Mississippi during 1958. Because of the lack of demonstrated effectiveness of any programs including an eradicant, no work with eradicants was planned.

Converse (33) tested zineb and maneb in a comparative test with Bordeaux mixture in a test of protectants during the 1953 season on the George Spraberry farm (now Barney Brown Ranch) near Paden, Oklahoma². All of the test materials provided good control during this dry season (Table 3).

²Fungicide trials have been conducted continuously on this farm since 1953 on scab-susceptible Western and Squirrel trees.

Table 2. Increase in scab on nut shucks of Squirrel cultivar trees sprayed with dormant season eradicants followed by full season protectant applications of Zerlate, 1945.¹

Eradicant formulation 3/21/53	Protectant formulation (full season)	Number of lesions per nut			Percent area scabbed on mature nuts Sept. 25
		June 25	July 28	Aug. 28	
Corona CM220 3 lbs/100 gals	Zerlate, 2 lbs/100 gals	0	3.70	45.6	21.4
Elgetol 1 gal/100 gals	"	0	2.44	72.1	29.7
United Chemical Dormant Fun- gicide 4 lbs/100 gals	Zerlate, 2 lbs/100 gals	0	1.15	70.3	34.1
None (Check)	-----		6.22	183.3	47.6
LSD (5%)			5.46	51.0	
LSD (1%)				73.4	

¹Data modified from Converse (24).

During 1957, Converse (27) compared the effectiveness of maneb, zineb, ziram, thiram, folpet, Dyrene 50W and Thioneb as protectants. All of the dithiocarbamic acid derivatives (maneb, zineb and ziram) and Dyrene 50W provided excellent control during this relatively dry season. Folpet provided fairly good control, but thiram and Thioneb were not very effective (Table 4) and all three materials were withdrawn from further testing.

1958-1976 PERIOD

All of the materials tested from 1958 through 1962 were applied with a single-nozzle spray gun from a conventional hydraulic spray machine operating at 600 to 800 psi. Approximately 20 gallons of spray were applied to each

Table 3. Effectiveness of certain protectant fungicides for pecan scab control on Western cultivar trees, 1953.¹

Fungicide formulation	Lbs/100 gals. of spray material	Percent area of shucks of mature nuts with scab lesions
Dithane Z-78	2	1.2
Manzate	2	1.3
Bordeaux mixture (copper sulfate + lime)	6+2	1.6
Zerlate	2	6.1
None (Check)	-	62.4

¹Data from Converse (23)

Table 4. Effectiveness of certain protectant fungicides for scab control on Western cultivar pecan trees, 1957¹

Fungicide formulation	Pounds of formulation per 100 gallons of water ²	Average percent area of nut shuck scabbed
Dyrene 50W	3.0	0.0
Manzate	2.2	0.2
Dithane Z-78	2.3	0.5
Zerlate	2.0	0.7
Phaltan	2.0	1.9
Thioneb	1.5	3.4
Thylate	2.3	4.4
None (Check)	---	12.9

¹Data from Converse (27)

²Sprayed five times

mature tree at each spraying date. All materials tested from 1963 through 1976 were applied with a conventional speed sprayer (John Bean CP 703) equipped with a pecan volute to ensure good coverage of trees from top to bottom. Approximately 25 gallons of spray were applied to each mature tree at each spraying date during the 1963-1967 seasons. Beginning in the 1968 season 25 to 35 gallons of spray were applied to each test tree at each spraying.

1958 Season

During the very wet 1958 season, Barnes (1, 2) tested zineb, ziram, maneb and Dyrene at Paden. Dyrene and zineb provided excellent control, maneb gave poor control and ziram was ineffective (Table 5). The results with zineb, ziram and maneb agree with those obtained by Large (40) in Florida during many years of testing. After the 1958 test, zineb formulations were recommended for scab control in Oklahoma and the ziram and maneb formulations were dropped from the list of materials suggested for use because of their poor performance in several states (1, 2, 40).

1959 Season

During 1959, a new fungicide, dodine, which had provided excellent scab control in Georgia during 1958 (20, 21) was tested in Oklahoma along with zineb, ziram, Dyrene, Amobam, Dibam A and Brodeaux mixture (3, 4). Dyrene, dodine, Bordeaux mixture and zineb provided excellent control but Amobam, Dibam A and ziram were ineffective (Table 6). Though dodine and Dyrene were effective in several tests, they could not be suggested for use on pecans during the 1960 season because residue tolerances and application

Table 5. Effectiveness of certain protectant fungicides for controlling scab on Squirrel cultivar pecan trees, Paden, Oklahoma, 1958.

Fungicide formulation ¹ (1.5 pounds active ingredient/100 gal. of spray material)	Weight of 50 nuts with shucks ² (grams)	Average shuck surface scabbed (percent)	Nuts per pound (11/21)
Dyrene 50W	269.9	22	113
Parzate	222.9	20	114
Manzate	123.9	60	162
Zerlate	36.4	96	207
None (Check)	10.4	100	0 ³

¹Eight application: 5/7, 6/2, 6/27, 7/9, 7/30, 8/12, 9/2 and 9/18.

²Ten nuts from each of five trees per treatment. Samples obtained on 10/6.

³Nuts were so diseased and small and had such tightly-adhering shucks that samples could not be obtained.

Table 6. Effectiveness of certain protectant fungicides for scab control on Western Cultivar pecan trees in Oklahoma, 1959.

Fungicide formulation	Treatment Rate/100 gallons of spray material	Scab control rating (foliage and nuts) ²	Average number of nuts per pounds ³
Parzate	3 lb.	Excellent	58
Parzate + Standard Superla Summer Oil	3 lb. + 1 pt.	Excellent	67
Dithane Z-78	3 lb.	Excellent	57
Tank mix zineb (nabam + ZnSO ₄)	2 qt. + 1.25 lb.	Excellent	74
Zerlate	3 lb.	Very Poor	112 ⁴
Niacide Z	4 lb.	Very Poor	124 ⁴
Tank mix ziram (Dibam A + ZnSO ₄)	1 qt. + 1.25 lb.	Poor	93 ⁴
Bordeaux mixture (CuSO ₄ + lime)	6 lb. + 2 lb.	Good	78
Dyrene 50W	4 lb.	Excellent	64
Cyprex 65W	1 lb.	Excellent	84
Cyprex + Standard Superla Summer Oil	1 lb. + 1 pt.	Excellent	62
Dibam A	1 qt.	Very Poor	146 ⁴
Amobam	1 qt.	Very Poor	108 ⁴
None (Check)	----	-----	215 ⁵

¹Two-week schedule. Nine applications (4/24, 5/7, 5/20, 6/3, 6/18, 7/2, 7/16, 7/31, 8/14)

²Determined in October

³Nuts collected, weighed and counted on November 5 and 6. Disease-free Western variety nuts will usually average between 60 and 65 nuts per pound.

⁴Nuts only partially filled and not marketable.

⁵Unfilled nuts with tightly-adhering, scab-blackened shucks.

limitations on pecans had not been established by the Food and Drug Administration (FDA) and the U.S. Department of Agriculture (USDA).

1960, 1961 and 1962 Seasons

During the 1960 season, three fungicides (zineb, dodine, and Dyrene 50W) singly and in conjunction with an adjuvant (spreader-sticker or sticker) were evaluated for scab control (5). Adjuvants are usually relatively inert materials added to a spray mix to improve the physical characters of the toxicant by improvement of the physical factors to increase effectiveness of the toxicant (49). Each fungicide alone, and in conjunction with an adjuvant, provided equivalent commercial control (Table 7). The addition of an adjuvant, at the rates tested, did not improve the efficiency of any of the fungicides.

Table 7. Effectiveness of certain protectant fungicides for scab control on Western cultivar pecan trees at Paden, Oklahoma, 1960.

Fungicide formulation	Rate/100 gallons of spray	Application interval	Average no. of nuts/lb ¹ (11/8/60)
Parzate	3 lb.	2 wk. ²	58
Cyprex 65W	1 lb.	"	61
Dyrene 50W	4 lb.	"	58
Parzate	3 lb.	3 wk. ³	63
Cyprex	1 lb.	"	64
Dyrene 50W	4 lb.	"	67
Parzate + Plyac	3 lb. + 2 oz.	"	61
Parzate + duPont Sticker Spreader	3 lb. + 2 oz.	"	59
Parzate C + Esso LO-3328	3 lb. + 1 qt.	"	62
Cyprex + Plyac	1 lb. + 2 oz.	"	67
Cyprex + P.e.p.s.	1 lb. + 8 oz.	"	65
Dyrene + Plyac	4 lb. + 2 oz.	"	62
Dyrene + P.e.p.s.	4 lb. + 8 oz.	"	63
Dithane Z-78 + P.e.p.s.	3 lb. + 8 oz.	"	62
None (Check)	-----	----	90 ⁴

¹Disease-free Western variety nuts usually average between 60 and 65 nuts per pound.

²Eight applications: 5/9, 5/23, 6/6, 6/20, 7/5, 7/18, 7/29, and 8/15.

³Five applications: 5/10, 5/31, 6/21, 7/12, and 7/29.

⁴Nuts incompletely filled and non-marketable.

Because of its effectiveness, the FDA and USDA approved for use on pecans, dodine was added to the list of suggested materials for scab control in Oklahoma during 1961.

Results from tests conducted during the 1961 and 1962 seasons confirmed the effectiveness of zineb and dodine fungicides (Table 8 and 9) whereas two experimental materials, OMCC-1763, and GC-2466, were ineffective (6) and were dropped from further testings.

1963 Season

During the 1963 season, Dyrene 50W, dodine, zineb, and an emulsifiable copper fungicide (TC-90), and a formulation containing both maneb and zinc ions (Dithane M-45) were tested (6). All of the materials provided excellent control (Table 10). Dyrene 50W, though effective, had not yet been approved for use on pecans by FDA and USDA, and could not be added to the list of recommended materials for 1964. Dithane M-45 and TC-90 were retested

Table 8. Effectiveness of certain protectant fungicides for scab control on Squirrel cultivar pecan trees at Paden, Oklahoma, 1961.

Treatment		
Fungicide formulation	Lbs/100 gallons of spray ¹	Average no. of nuts per pounds
Cyprex 65W	1/2	68
Cyprex 65W	1	76
Parzate C	2	70
Dithane Z 78	2	68
OMCC-1763	2	114
GC-2466	1	132
None (Check)	---	151 ²

¹Seven applications: 5/10, 5/24, 6/8, 6/22, 7/6, 7/20, and 8/3.

²Nuts incompletely filled and non-marketable.

Table 9. Effectiveness of certain protectant fungicides for scab control on Squirrel cultivar pecan trees at Paden, Oklahoma, 1962.

Treatment			
Fungicide formulation	Lbs./100 gallons of spray	Application Interval (weeks)	Average number of nuts/lb.
Cyprex 65W	1/2	2	66
Cyprex 65W	1/2	3	72
Cyprex 65W	1	2	74 ¹
Cyprex 65W	1	3	70
Cyprex 65W	1	4	71
Dithane Z-78	2	2	66
Dithane Z-78	2	3	76
None (Check)	---	--	-- ²

¹Much stinkbug damage resulted in many lightweight nuts in the treatment.

²Nuts not weighed. These trees were inadvertently sprayed several time with fungicides.

during the 1964 season to obtain additional data on their effectiveness. Dyrene was later withdrawn from further testing on pecans at manufacturers request.

1964 and 1965 Seasons

During 1964, a new material, Du-Ter 20W, was tested at Paden. Polyram 80WP was also tested as it had provided good control in an exploratory test by Hinrichs at the Pecan Research Station at Sparks, Oklahoma (30). Other materials were included for retesting or as references. All of the fungicides

Table 10. Effectiveness of certain protectant fungicides for scab control on Squirrel cultivar pecan trees at Paden, Oklahoma, 1963.

Treatment		
Fungicide formulation	Rate/100 gallons of spray material ¹	Average no. of nuts per pound ²
Dithane Z-78	2lbs.	57
Dithane M-45	2lbs.	56
Dyrene 50W	2lbs.	56
Dyrene 50W	4lbs.	58
Cyprex 65W	1/2lb.	52
Cyprex 65W + Plyac	1/2lb. + 4 oz.	55
TC-90	3/4gal.	57
None (Check)	-----	112 ³

¹Two-week application interval. Eight applications: 5/1, 5/15, 6/12, 6/26, 7/10, 7/24, 8/7, and 8/21.

²Disease-free Squirrel variety nuts usually average between 55 and 60 nuts per pound.

³Incompletely filled nuts with blackened, tightly-adhering shucks (non-marketable).

Table 11. Effectiveness of certain protectant fungicide for pecan scab control at Paden, Oklahoma, 1964.

Treatment			
Fungicide formulation	Rate/100 gallons of spray material	Application interval (weeks)	Average number of nuts/lb.
Western Cultivar			
Parzate C	2 lb.	2 ¹	70
Parzate C + Thylate	1 1/2 lb. + 1 lb.	2	62
Parzate C	1 1/2 lb.	2	62
Dithane Z-78	2 lb.	2	64
Dithane M-45	2 lb.	2	62
TC-90	3/4 gal.	3 ²	59
None (Check)	---	--	98 ³
Squirrel Cultivar			
Cyprex 65W	1/2 lb.	2 ¹	54
Polyram 80WP	1 1/2 lb.	2	53
Du-Ter 20W	1 lb.	2	66
Du-Ter 20W	2 lb.	2	54
Cyprex 65W	1/4 lb.	3 ²	51
Cyprex 65W	1/2 lb.	3	51
Cyprex 65W + Plyac Spreader-Sticker	1/4 lb. + 6 oz.	3	55
	-----	--	79 ³

¹Application dates: 5/14, 6/4, 6/19, 7/2, 7/20, 8/5, 8/20, and 9/16.

²Application dates: 5/14, 6/4, 7/20, and 8/20.

³Incompletely-filled, very poor quality nuts.

effectively controlled scab under conditions promoting only mild scab development (6) (Table 11). It appeared that Cyprex 65W (65 percent dodine) at 1/4 lb/100 gallons of spray (1/2 lb is suggested) would be effective during "very mild scab" seasons. Dithane M-45 and Polyram 80WP were approved for use on pecans by FDA and USDA and were added to the list of materials suggested for use in Oklahoma.

All of the 1964 materials were retested in 1965, and most of them provided good control including Cyprex at 1/4 lb. (7, 8) (Table 12). Because TC-90 provided only fair to good control of scab during several years of testing and also had problems associated with handling and use of the formulation (a viscous liquid), it was not tested further.

1966 Season

During 1966, Brestan 60 (triphenyl tin acetate and maneb) was tested for the first time in Oklahoma. A new formulation of Du-Ter (47.5 percent TPTH) was tested in place of Du-Ter 20W, at company request, and corresponding lower rates were used. Excellent data were obtained for those materials tested on the Squirrel variety (9, 10). Western cultivar trees were heavily damaged by late spring freezes. Many of these trees did not bear and many of the nuts that did form were later damaged by early fall freezes. Because of the

Table 12. Effectiveness of certain protectant fungicides for pecan scab control at Paden, Oklahoma, 1965.

Fungicide Formulation	Treatment	
	Rate/100 gallon spray ¹	Average no. of nuts per pound
Squirrel Cultivar		
Cyprex 65W	1/4 lb.	59
Cyprex 65W	1/2 lb.	56
Polyram 80WP	2 lb.	60
Dithane M-45	2 lb.	60
Dithane Z-78	2 lb.	61
TC-90	3/4 gal.	77
None (Check)	----	102 ²
Western Cultivar		
Manzate D	2 lb.	70
Parzate C	2 lb.	71
Du-Ter 20W	1 1/2 lb.	72
None (Check)	----	100 ²

¹Application dates 5/5, 5/19, 6/3, 6/17, 7/3, 7/19, 8/4, 8/19, and 9/7.

²Incompletely filled, very poor quality nuts.

absence of a crop on the Brestan sprayed trees, an evaluation of the effectiveness of this material could not be made. The other materials applied to Western trees appeared to have provided excellent control (9, 10) (Table 13). Du-Ter was approved for use on pecans by the FDA and USDA during 1966. Because of its effectiveness, it was added to the list of suggested materials for scab control in Oklahoma beginning with the 1967 season.

1967 Season

During 1967, Brestan 60 and Manzate D were retested and a formulation of copper hydroxide, Kocide 101, was tested for the first time in Oklahoma. All of the recommended materials were included as reference compounds. All of the test materials, except Kocide 101, provided good to excellent control (Table 14). A high rate of Brestan, for some unexplained reason, did not provide excellent control as did a low rate. Manzate D provided excellent control during the 1965-1967 seasons and it was scheduled for additional testing during the 1968 season.

Table 13. Effectiveness of certain protectant fungicides for pecan scab control at Paden, Oklahoma, 1966.

Fungicide formulation	Treatment Rate/100 gallons of spray material	Average number of nuts/lb.
Squirrel Cultivar		
Cyprex 65W	1/4 lb.	73
Cyprex 65W	1/2 lb.	68
Polyram 80W	2 lbs.	62
Dithane M-45	2 lbs.	60
Manzate D	2 lbs.	67
None (Check)	----	216 ²
Western Cultivar		
Brestan 60	1/2 lb.	63 ³
Brestan 60	3/4 lb.	85 ³
Du-Ter	1/4 lb.	67 ⁴
Du-Ter	1/2 lb.	65 ⁵
Dithane Z-78	2 lbs.	67
None (Check)	----	159

¹Spray application dates: 5/18, 6/9, 6/30, 7/30, 8/27, and 9/15.

²Very small nuts with tightly-adhering shucks and little or no kernels.

³Determined from a single tree. Other trees did not bear. (Late spring frost damage).

⁴Determined from three trees. Other trees did not bear. (Late spring frost damage).

⁵Determined from two trees. Other trees did not bear. (Late spring frost damage).

Table 14. Effectiveness of certain protectant fungicides for pecan scab control at Paden, Oklahoma, 1967.

Fungicide formulation	Rate of formulation/100 gallons of spray material	Average number of nuts/lb/tree
Squirrel Cultivar		
Manzate	2.0 lbs.	72
Manzate D	2.0 lbs.	79
Du-Ter	3 oz.	84
Du-Ter	4 oz.	79
Cyprex 65W	0.5 lb.	74
Polyram 80W	1.5 lbs.	66
Dithane M-45	2.0 lbs.	78
None (Check)	----	166 ²
Western Cultivar		
Parzate C	2.0 lbs.	89
Dithane Z-78	2.0 lbs.	87
Brestan 60	0.5 lb.	79
Brestan 60	0.75 lb.	102
Kocide 101	2.0 lbs.	100
None (Check)	----	126 ²

¹Each material was applied to 10 test trees except for Cyprex 65W Manzate, Dithane Z-78, Brestan 60 and Kocide 101 which were applied to five trees each. All of the materials were applied 10 times: 5/4, 5/18, 6/1, 6/15, 7/1, 7/13, 7/28, 8/11, 8/30, and 9/15.

²Deformed, incompletely-filled, non-marketable nuts.

Kocide 101, because of its poor performance, was withdrawn from further testing. A new fungicide, F-1991, containing benomyl, was given a preliminary screening at Stillwater in an orchard of young Burkett trees. Benomyl attracted a great deal of research interest after it was reported to be a highly effective, wide-spectrum, systemic, curative, and protectant fungicide (28). Moderate scab developed on foliage of nonsprayed control (check) trees but no scab disease was evident on foliage of trees sprayed with F-1991 + Surfactant F (8 oz + 4 oz/100 gal equivalent) at 2- and 4- week intervals (11). Control of scab with benomyl applied every 4 weeks prompted an investigation on extended interval application on mature, bearing trees at Paden.

1968 Season

During 1968, F-1991 and Manzate D were included in the testing program at Paden. F-1991 was applied at 2,4- and 5-week intervals. Previously evaluated fungicide formulations were included as reference materials. The season was very rainy and several times the sprayer could not be pulled

through the orchard at scheduled spraying dates. Consequently, valid data could not be obtained. In addition, nut samples were inadequate because many of the trees had a very light crop due to heavy rains during the pollination period. At Stillwater during the 1968 season, Difolatan and Cyprex were compared at a rate equivalent to 1 pound per 100 gallons. Difolatan did not provide control equivalent to that of Cyprex and was not considered for further testing.

1969 Season

During 1969, Benlate, Manzate D and Manzate 200 were tested as experimental fungicides. Benlate was tested at 2- and 4-week application intervals. Polyram and Du-Ter were included as reference fungicides. All tested materials effectively controlled scab (Table 15) (11). Benlate controlled scab when applied every 4 weeks about as well as other materials applied every 2 weeks. This result prompted planning of further testing of Benlate on extended interval schedules during the 1970 season.

Results obtained in other states with Benlate for control of pecan scab have been similar to those in Oklahoma investigations. Excellent control was obtained in Alabama (41), Georgia (54), and Mississippi (33) when this

Table 15. Effectiveness of certain fungicides for pecan scab control at Paden, Oklahoma, 1969.

Fungicide formulation	Rate of formulation/100 gallons of spray mix	Application interval (wks)	Average no. nuts/lb.
Squirrel Cultivar			
Polyram 80W	2 lbs.	2 ¹	82 ³
Manzate D	2 lbs.	2	87
Manzate 200	2 lbs.	2	84
None (Check)	----	--	None
Western Cultivar			
Polyram 80W	2 lbs.	2	89
Du-Ter	4 oz.	2	101
Du-Ter	6.4 oz.	2	94
Benlate	6 oz.	2	90
Benlate	6 oz.	4 ²	94
None (Check)	----	--	175 ⁴

¹Schedule: 5/5, 5/17, 5/29, 6/9, 6/23, 7/7, 7/21, 8/4, 8/18, 9/11, 9/15.

²Schedule: 5/5, 5/29, 6/23, 7/21, 8/18, 9/15.

³Nuts were smaller than normal because of very hot and dry conditions during a critical part of the late development and filling period.

⁴Nuts deformed, incompletely filled and non-marketable.

formulation was applied every 3 weeks. Control with a 4-week application interval was also obtained in Georgia (22). Because Manzate D had been shown to be effective during the 1965-1967 and 1969 seasons it was placed on the list of materials suggested for pecan scab control beginning with the 1970 season. Because the active ingredient of Manzate 200 is very similar to that of Manzate D, this formulation was also added to the list.

During 1969 Hinrichs (37) evaluated Cyprex, Dithane Z-78, Du-Ter, and Du-Ter plus Savol (a spray oil) for control of scab on Western cultivar trees at the Department of Horticulture Pecan Research Station at Sparks. Cyprex effectively controlled scab followed by Du-Ter plus Savol, Du-Ter and Dithane Z-78 in that order (Table 16). Du-Ter plus Savol looks rather promising and should be tested further.

1970 Season

During 1970 Benlate was tested for effectiveness when applied every 4 and 5 weeks in comparison with Polyram and Du-Ter applied every 2 weeks. Orchex 795 and Orchex 796, spray oils, were added to a Benlate treatment and to a Du-Ter treatment, respectively, to determine whether these adjuvants would improve the activity of either material. The adjuvants did not improve the effectiveness of either material. Each Benlate treatment provided control equivalent to that provided by the reference materials (Table 17) (11). The effectiveness of Benlate when applied every 5 weeks was regarded as phenomenal and prompted work with longer intervals in the 1971 season.

At Stillwater, EL-273, reported to be effective for control of apple scab (17), was given a preliminary testing at 4 rates (20, 40, 60 and 80 ppm actual ingredient) on scab-susceptible Burkett trees. EL-273 did not effectively control pecan scab at the tested rates and was withdrawn from further testing.

Table 16. The effect of certain fungicide treatments on control of pecan scab at the Pecan Research Station, Sparks, Oklahoma, 1969. (Modified from Hinrichs (37).

Fungicide formulation	Rate of formulation/ gallons of spray mix	Number of infected nuts ² infection classes ³				
		1	2	3	4	5
Western Cultivar						
Du-Ter	0.3	190	177	130	3	0
Du-Ter + Savol	0.3 lb + 1 gal.	366	68	66	0	0
Cyprex 65W	0.5 lb.	444	39	17	0	0
Dithane Z-78	3 lbs.	151	67	197	85	0

¹Savol is a spray oil produced by Thompson-Hayward Chem. Co.

²500 nuts evaluated per treatment

³Infection classes: 1 = No scab lesions, 2 = 1-3 scab lesions, 3 = 4-10 scab lesions, 4 = Many lesions (up to half of nut covered), and 5 = Shuck completely covered by scab lesions.

Table 17. Effectiveness of certain fungicides for pecan scab control at Paden, Oklahoma, 1970.

Fungicide formulation	Rate of formulation/100 gallons of spray mix	Application interval (Weeks)	Average no. nuts/lb/tree
Squirrel Cultivar			
Benlate	6 oz.	4 ¹	61
Du-Ter	4 oz.	2 ²	59
Du-Ter + Orchex 796	4 oz. + 5 qt	2	65 ³
Du-Ter	6.5 oz.	2	58
Polyram 80W	2 lb.	2	60
None (Check)	----	--	---- ⁴
Western Cultivar			
Benlate	6 oz.	4	61
Benlate	6 oz.	5 ³	59
Benlate + Orchex 795	6 oz. + 5 qt.	5	68 ⁵
Polyram 80W	2 lb.	2	60
None (Check)	----	--	183 ⁶

¹4-week schedule: 5/13, 6/10, 7/8, 8/5, 9/2.

²2-week schedule: 5/13, 6/10, 6/24, 7/8, 7/22, 8/5, 8/19, 9/2, 9/16.

³5-week schedule: 5/13, 6/17, 7/22, 8/26.

⁴Nuts so badly diseased, small, and with such tightly-adhering shucks that nut samples could not be sampled.

⁵A pooled 1 lb. sample (trees bore very poorly).

⁶Nuts deformed, incompletely filled, and non-marketable.

1971 Season

During 1971, Benlate was tested to determine its effectiveness when sprayed on long interval schedules. Benlate was applied at 4, 6 and 8 week intervals. Plyac Spreader Sticker was reported to enhance the effectiveness of Benlate for control of apple scab (30) and it was added to Benlate and the mixture was applied at 6 and 8 week intervals. All Benlate treatments effectively controlled pecan scab and the addition of Plyac did not enhance or reduce its effectiveness (Table 18) (12, 13). The effectiveness of Benlate for extended periods is attributed to its systemic activity, probably of a localized nature, in pecan tissues. Fungitoxic activity of Benlate for such extended periods is phenomenal and makes this material very promising for economical control of pecan scab. Further testing was planned for the 1972 season.

1972 Season

During the 1972 season Benlate was evaluated again for its long term effectiveness. Applications were made every 4, 6 and 8 week. A formulation of another fungicide, Topsin M, whose actual toxicant formed in water is the

Table 18. Effectiveness of certain fungicides for control of pecan scab at Paden, Oklahoma, 1971.

Fungicide formulation	Rate of formulation/100 gallons of spray mix	Application interval (weeks)	Average no. nuts/lb/tree
Squirrel Cultivar			
Cyprex 65W	12.0 oz.	2 ¹	74
Cyprex 80W	9.6 oz.	2	77
Du-Ter	8.0 oz.	2	70
None (Check)	-----	--	86
Western Cultivar			
Benlate	6 oz.	2	69
Benlate	6 oz.	4 ²	71
Benlate	6 oz.	6 ³	75
Benlate + Plyac Spreader-Sticker	6 oz. + 6 oz.	6	76
Benlate + Plyac Spreader-Sticker	6 oz. + 6 oz.	8 ⁴	80
None (Check)	-----	--	107 ⁵

¹2-week schedule: 5/4, 5/18, 6/1, 6/15, 6/29, 7/13, 7/27, 8/10, 8/24, 9/7, 9/21.

²4-week schedule: 5/4, 6/1, 6/29, 7/27, 9/7.

³6-week schedule: 5/4, 6/15, 7/27, 9/7.

⁴8-week schedule: 5/4, 6/29, 8/24.

⁵Nuts deformed, not filled, and non-marketable.

same as that formed from the active ingredient of Benlate (51) was applied every 2 and 4 weeks. Du-Ter, applied every 2 weeks was used as a reference fungicide.

The 1972 season was very dry and many of the test trees did not bear or bore very poorly. As the season progressed, much of the small crop dropped prematurely. Consequently, an adequate research sample could not be obtained from each test tree. However, a very small composite sample was obtained from most of the treatments. The data, therefore, are questionable but are presented in Table 19. No data were obtained for the 6- and 8-week treatments. Both Benlate and Topsin M when applied every 4 weeks, apparently provided control equivalent to that provided by Du-Ter applied every 2 weeks. Extended interval tests with both materials are being utilized for the 1973 season.

Benlate was approved by the Environmental Protection Agency (EPA) in February, 1973, for use on pecans at rates that would leave only a negligible residue. Earlier experimental use of Benlate on test trees at Paden was permitted under USDA temporary Permit No. 352-EXP-71G. Because of EPA approval for use on pecans and because of its long term effectiveness, Benlate 50W was suggested to be used on pecans at 8 oz/100 gals applied every 4 weeks during wet seasons or every 4 to 6 weeks during drier periods.

Table 19. Effectiveness of certain fungicides for control of pecan scab at Paden, Oklahoma, 1972.

Fungicide formulation	Treatments		Average no. nuts/lb/tree ¹
	Rate (oz/100 gal)	Application interval (weeks)	
Squirrel Cultivar			
Benlate	6	4	58
Benlate	8	4	57
Benlate	8	6	-- ²
Benlate	8	8	-- ²
Topsin M	8	2	55
Topsin M	8	4	57
Du-Ter	8	2	59
None (Check)	--	--	94 ³

¹Number determined from a composite sample consisting of 12 oz. to 2 lbs. from 6 trees per fungicide treatment.

²No sample available. Trees did not bear.

³At the end of a severe scab season, this figure would have been much larger. Limited scab developed during the relatively dry 1972 season.

1973 Season

The manufacturers of several formerly USDA-and FDA-approved pecan scab control fungicide formulations (Dithane Z-78, Dithane M-45, Parzate C, Manzate D and Manzate 200) withdrew recommendations for their use on pecans because of the great costs involved in obtaining EPA clearance for use on this low priority crop. Because of the subsequent drastic shortening of the list of approved materials, it was deemed essential to step up research on extended-interval applications of Benlate and Topsin M in the 1973 season.

Benlate was applied at 4, 6, and 8 weeks intervals, Topsin M and Du-Ter were applied every 4 weeks and Cyprex was applied every 2 weeks as a reference standard treatment. The 4-week schedule with Du-Ter was included because of a preliminary report from Florida that 3, 4, and 5 week interval applications provided scab control comparable to that provided by Benlate (31).

Spray adjuvants, such as stickers and spreaders, sometimes enhance or extend the activity of fungicides (49). Therefore, it was planned to include Benlate, in conjunction with Nu-film 17 (Miller Chem. Co.), applied every 6 weeks.

During this "mild" scab season, Benlate without an adjuvant provided excellent control when applied every 4-weeks, good control when applied every 6 weeks and poor control when applied every 8 weeks; Topsin M provided good control, but Du-Ter provided poor control (Table 20) (14, 15). The addition of Nu-Film 17 did not enhance the activity of Benlate.

Table 20. Control of Pecan scab at the Barney Brown Ranch near Paden, Oklahoma, 1973.

Fungicide formulation	Rate of formulation/100 gal spray mix	Application interval (weeks) ¹	Average no. of nuts/lb/tree
Squirrel cultivar			
Benlate 50W	6 oz.	4 ²	60
Benlate 50W	8 oz.	6 ³	66
Benlate 50W	1 lb.	8 ⁴	81
Benlate 50W + Nu-Film 17	6 oz. + 4 oz.	6	66
Benlate 50W + Nu-Film 17	6 oz. + 1 lb.	6	69
Du-Ter	12 oz.	4	73
Cyprex 65W	8 oz.	2 ⁵	81
None (Check)	----	---	120
Western cultivar			
Topsin M	8 oz.	4	65
Benlate 50W	8 oz.	6	62
Cyprex 65W	8 oz.	2	61
None (Check)	----	---	--- ⁶

¹Materials applied with a John Bean 703 CP speed sprayer equipped with a pecan volute. Insecticides (Guthion, Sevin, Malathion, etc.) were applied at appropriate times to control pecan casebearers, aphids hickory shuckworms and pecan weevils.

²Application dates: 5/4, 6/1, 6/29, 7/27, 8/24.

³Application dates: 5/4, 6/8, 7/20, 9/14 (delayed 2 weeks - rain).

⁴Application dates: 5/4, 6/29, 8/24.

⁵5/4, 5/18, 6/1, 6/15, 6/29, 7/13, 7/27, 8/10, 8/24, 9/14 (delayed 1 week - rain).

⁶No yield.

Benlate will be continued to be suggested to be used at 8 oz/100 gallons of spray mix every 3 to 4 weeks during very wet seasons and every 4 to 5 weeks during drier seasons. In view of the poor control provided by Du-Ter applied every 4 weeks, it will still be suggested that the 2 week schedule be followed. Benlate controls powdery mildew better than Du-Ter but control decreases somewhat at the longer spray intervals. Topsin M, though effective in this and earlier tests could not be suggested for grower use as it was not approved by EPA for use on pecans. It will be tested further.

1974 Season

Extended interval applications of Benlate have provided excellent control of scab for as long as 4 weeks during wet seasons in Oklahoma but activity is lessened with time after 4 weeks. Therefore, it was planned to continue testing of adjuvant materials in an effort to extend the highly effective period. A summer spray-oil, Sunspray 7-E (Sunmark Industries), was tested because of a report of good control of apple scab with benomyl-oil-water emulsions (53).

Nu-Film 17 was used again but in a 5-week schedule. Another summer spray oil formulation, Savol (Thompson-Hayward Chem. Co.), was used with Du-Ter to obtain additional data related to the good results obtained by Hinrichs in 1969 (37).

Severe scab developed on non-fungicide-sprayed check trees. Cyprex applied every 2 weeks and Benlate, Du-Ter, and Topsin M applied every 4 weeks provided excellent control (Table 21). Benlate applied every 5 weeks with and without adjuvants provided equivalent control. A mixture of Du-Ter and Savol applied every 4 weeks provided significantly less control than with Du-Ter alone. No further testing of fungicide-adjuvant mixtures was planned because of the lack of demonstrated benefits.

At Stillwater, several experimental materials were tested in comparison with Benlate. DPX-10 was included at the manufacturers request, Copper Count N was included because of its activity against a variety of fungi, and CELA W-524 was included because it had previously provided some control of pecan scab in Alabama (42). Benlate, DPX-10 and Copper Count N provided

Table 21. Effectiveness of certain fungicidal materials for control of Pecan scab at Paden, Oklahoma, 1974.

Fungicide formulation	Rate of formulation/100 gal spray mix	Application Interval (Weeks)	Average no. of nuts/lb./tree
Squirrel cultivar			
Benlate 50W	8 oz.	4 ¹	58.50
Benlate 50W	8 oz.	5 ²	64.83
Benlate 50W + Nu-Film 17	8 oz. + 2 pts.	5	62.17
Benlate 50W + Sunspray 7-E	8 oz. + 2 qts.	5	61.50
Du-Ter	8 oz.	4	61.20
Du-Ter + Savol	8 oz. + 1 gal.	4	70.17
Cyprex 65W	8 oz.	2 ³	57.50
Topsin M	8 oz.	4	59.80
None (Check)	----	----	203.00 ⁴
Analysis of variance		L.S.D. 0.05	4.22
Western cultivar			
Bravo 6F	3 pts.	2	64
Difolatan 4F	1.2 qts.	2	74
Difolatan 4F	1.8 qts.	2	65
Cyprex 65W	8 oz.	2	65
None (Check)	----	--	113 ⁴

¹4-week schedule: 5/8, 6/12 (delayed-rain), 7/3, 7/31, 8/28.

²5-week schedule: 5/8, 6/12, 7/17, 8/21.

³2-week schedule: 5/8, 5/22, 6/12, (delayed-rain), 6/19, 7/3, 7/17, 7/31, 8/14, 8/24, 9/11.

⁴Nuts small, deformed, incompletely-filled, and non-marketable.

good control but W-524 provided only fair control (Table 22). W-524 was not planned to be evaluated further. Further testing of DPX-10 and Copper Count N was planned for 1975.

1975 Season

During 1974 reports of development of Benlate-resistant strains of a variety of fungi were published (see references 16 and 44). Of particular interest to those involved in research on pecan scab control were the reports on development of Benlate-resistant strains of the apple scab fungus because the two fungi involved are very closely related. Therefore, the manufacturer of Benlate and the author decided to test mixtures of Benlate and Cyprex or Du-Ter on a typical 4 week Benlate schedule in an attempt to control any resistant strains that may have developed in this orchard where trees have been sprayed with Benlate since 1968. Copper Count N, Difolatan 4F and Topsin M were also evaluated for scab control during 1975.

The 1975 season was very dry and even nuts from scab free trees were incompletely filled and unusually light weight. Only a moderate degree of scab developed on nuts in non-sprayed check trees. However, comparative control data were obtained (Table 23). Benlate applied alone provided significantly less control than the mixture or Cyprex or Du-Ter. This indicates that a Benlate-resistant strain of the scab fungus may be present in the orchard and that the mixtures or Du-Ter or Cyprex effectively controlled the resistant strain. A more economical control procedure would be to *alternate* Du-Ter or Cyprex applications with Benlate. It is advisable that season-long applications of Cyprex alone not be made because there is a possibility that a

Table 22. Effectiveness of fungicide materials for control of Pecan scab at Stillwater, Oklahoma, 1974.

Fungicide formulation	Rate of formulation/100 gal spray mix	Application interval (Weeks)	Average no. of nuts/lb./tree
Burkett cultivar			
DPX-10	8 oz.	4 ¹	65
Benlate 50W	8 oz.	4 ²	68
Cela W524	12 oz.	2 ³	75
Copper Count N	3 qts.	2	65
None (Check)	---	---	112 ⁴

¹4-week schedule: 6/5, 7/2, 7/29, 8/27.

²4-week schedule: 6/18 (delayed start), 7/15, 8/13, 9/8.

³2-week schedule: 5/20, 6/5, 6/18, 7/2, 7/15, 7/29, 8/12, 8/27, 9/8.

⁴Nuts small, deformed, incompletely-filled and non-marketable.

Table 23. Control of Pecan scab by certain fungicidal materials at Paden, OK., 1975.

Spray Treatments			
Fungicide	Rate/100 gal.	Application intervals (Weeks) ¹	Average no. of nuts/pound ²
Squirrel cultivar			
Cyprex 65W	8 oz.	2 ²	93.67
Du-Ter	8 oz.	2	90.17
Topsin M	6 oz.	4 ³	109.33
Topsin M	8 oz.	4	86.33
Benlate 50W	8 oz.	4	120.67
Benlate 50W + Du-Ter	8 oz. + 8 oz.	4	90.33
Benlate 50W + Du-Ter	12 oz. + 12 oz.	4	105.00
Benlate 50W + Cyprex 65W	8 oz. + 8 oz.	4	105.50
Benlate 50W + Cyprex 65W	8 oz. + 1 lb.	4	86.83
None (Check)	-----	---	-----
Analysis of Variance		LSD 0.05	24.53
		LSD 0.01	32.71
Western cultivar			
Copper Count N	2.5 qts.	2	116
Difolatan 4F	1.2 qts (3) followed by 2.0 qts (7) ⁴	2	134
Benlate 50W followed by Difolatan 4F	8 oz. Benlate (1) followed by Difolatan 1.2 qts (2) and then 2 qts. (7)	2	113
Cypex 65W	8 oz.	2	115
None (Check)	-----	---	167

¹Applied with a John Bean 703CP speed sprayer equipped with a pecan volute. Insecticides (Guthion, Sevin, Malathion) applied at appropriate times to control casebeareas, shuckworms, aphids and weevils.

²Application dates: 5/6, 5/20, 6/3, 6/17, 7/1, 7/15, 7/29, 8/12, 8/29, & 9/9.

³Application dates: 5/6, 6/3, 7/1, 7/29, 8/29.

⁴Numbers in parentheses refer to numbers of applications

⁵Dry, low-disease-severity season, nuts not completely filled, lightweight. Disease-free, well-filled Squirrel and Western cultivar nuts usually yield 55-60 nuts per pound.

Cyprex-resistant strain of the pecan scab fungus could develop as has already occurred with the apple scab fungus (50).

At Stillwater, three new experimental materials were evaluated: RP-26019, DPX-10 and Kasumin (Table 24). DPX-10 had been tested during 1974 and had provided excellent control. DPX-10 and Benlate were compared when applied every 6 weeks. DPX-10 and Benlate provided equivalent control and the duPont company asked that the new material not be tested further. RP-26019 and Kasumin provided poor control and were dropped from further testing.

Table 24. Control of scab on "Burkett" Pecan trees at Stillwater, Ok., 1975.

Fungicide formulation	Rate of formulation/100 gal spray mix ¹	Application interval (Weeks)	Average no. of nuts/lb./tree ²
RP-26019	8 oz.	2 ³	145 ⁵
RP-26019	1 lb.	2	143 ⁵
Benlate 50W	8 oz.	6 ⁴	104 ⁶
DPX-10 50W	8 oz.	6	106 ⁶
Kasumin 2%	756 ml.	2	195 ⁷
None (Check)	---	-	249 ⁷

¹Equivalent to amount actually used in 50 gallons of water for 3 trees per treatment at each spraying date.

²High correlation with degree of disease control.

³2-wk schedule: 5/20, 6/3, 6/19, (delayed - rain), 7/1, 7/15, 7/29, 8/12, 8/27.

⁴6-wk. schedule: 5/20, 7/1, 8/12.

⁵Shucks very scabby, nuts small and with tightly adhering shucks. Nuts completely filled. Weighed with shucks on.

⁶Shucks slightly scabby, nuts slightly small, and nuts incompletely filled. Weighed with shucks off.

⁷Shucks very scabby, nuts very small and malformed and with tightly adhering shucks. Nuts empty or incompletely filled. Weighed with shucks on.

Sevin (2 lbs/100) for insect control: 5/20, 7/8, 7/29, 9/4, 9/23.

1976 Season

Extensive fungicide tests were planned for the 1976 season at Paden, Sparks and Stillwater. At the Paden Research Station, Sparks, alternating applications of Benlate and Cyprex or Difolatan 4F along with appropriate control treatments were initiated. Two new experimental fungicides were planned to be evaluated at Stillwater. All of the 1976 tests were cancelled because there was no set of nuts at all 3 locations. (We always rely on nut scab evaluations because foliar scab is of no or little consequence on the pecan cultivars in our test orchards).

No further evaluations of fungicides for pecan scab control will be made. The scab control project was terminated June 30, 1977 for several compelling reasons. Approximately 90% of the nut production in Oklahoma is from highly scab-resistant native trees. Of the remaining trees ("Improved Varieties" and "seedlings") only a small percentage are sufficiently scab susceptible to require a scab-control program. Therefore, only a relatively few nut producers in the state were interested in the scab control research program. Without grower interest and supplementary financial support from grower organizations, the OSU Agricultural Experiment Station administration could not justify continuation of the project.

Conclusions and Use Suggestions

Research results from Oklahoma and other pecan states have shown that adhering to the following procedures is effective for control of pecan scab in Oklahoma.

1. When planting new orchards in areas where scab is a problem, avoid highly-scab susceptible cultivars such as Halbert, Western, Squirrel, Burkett, etc. unless a fungicide spray program will be followed. Also avoid the use of scion wood from these cultivars for grafting. There are many recommended cultivars available that are scab resistant or tolerant for use in scab areas in Oklahoma (Consult OSU Extension Fact Sheet 6201 "Pecan Varieties for Oklahoma").

2. In orchards containing scab-susceptible trees, allow adequate spacing between trees to allow good air circulation. Clean cultivation and removal of low branches will also aid air circulation. When branch tips from nearby trees approach each other, remove every other tree. All fallen scab-infected nut shucks, twigs, and leaves should be turned under by shallow disking or destroyed by burning. Destruction of infected plant parts will aid in control of several insects and in controlling several diseases.

3. Thoroughly spray scab-susceptible cultivars and native and seedling trees with a fungicide suggested for scab control at the rates listed on page ii.

4. To prevent development of Benlate-resistant strains of the scab fungus, one should alternate applications of Benlate with another scab-controlling fungicide or use another acceptable material.

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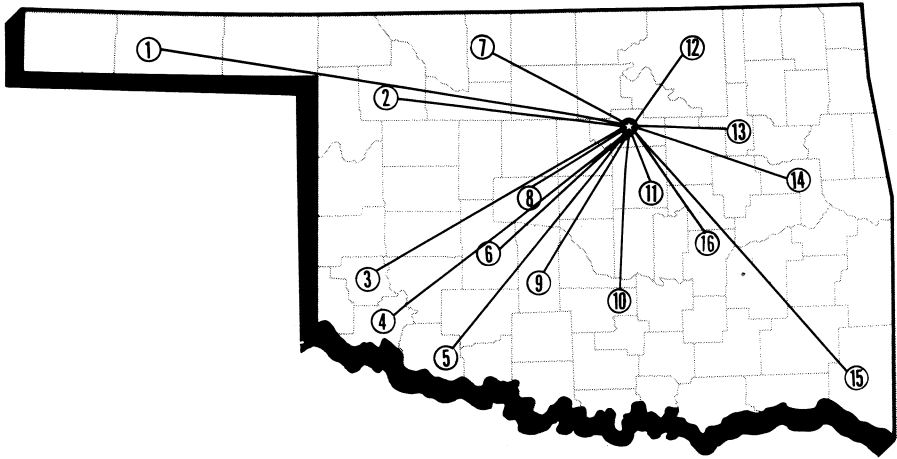
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OKLAHOMA

Agricultural Experiment Station

System Covers the State



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2. Southern Great Plains Field Station — Woodward
3. Sandyland Research Station — Mangum
4. Irrigation Research Station — Altus
5. Southwest Agronomy Research Station — Tipton
6. Caddo Research Station — Ft. Cobb
7. North Central Research Station — Lahoma
8. Southwestern Livestock and Forage Research Station — El Reno
9. South Central Research Station — Chickasha
10. Agronomy Research Station — Stratford
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12. Veterinary Research Station — Pawhuska
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15. Kiamichi Field Station — Idabel
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