

PLANT PATHOLOGY
Chemicals
for control of
Plant Diseases
in North Carolina



HOWARD R. GARRISS AND J. C. WELLS
PLANT PATHOLOGY EXTENSION
NORTH CAROLINA STATE UNIVERSITY

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Note: John W. Glover, Extension Agricultural Engineering prepared most of the information dealing with application equipment, calibration etc. occurring on pp. 44-56.

CHEMICALS FOR CONTROL OF PLANT DISEASES

H. R. GARRISS and J. C. WELLS, Plant Pathology Extension

The following types of chemicals are among those commonly used as fungicides, soil fumigants and antibiotics for plant disease control:

Copper fungicides—Bordeaux mixture (made of copper sulfate, lime and water), basic copper sulfate, copper carbonate, copper naphthenate, copper dusts.

Sulfur fungicides—Liquid lime-sulfur, dry lime-sulfur, wettable sulfurs, sulfur dusts.

Mercury fungicides—Mercuric chloride, phenyl mercury acetate and related organic mercury compounds.

Fumigants—Methyl bromide, dichloropropene, chloropicrin, sulfur, D-D, DBCP, ethylene dibromide, urea. Some of these are effective against fungus and nematode diseases while others are mainly effective against nematodes.

Antibiotics—Streptomycin nitrate, streptomycin sulfate, Terramycin, Actidione etc.

Organic fungicides—For convenience in labeling and other uses several of the organic fungicides have been given short common names for the active fungicidal chemical:

Common Name of Active Ingredient

Trade Names of Some Commercial Preparations Containing Fungicides

ferbam	Fermate, Karbam Black, Ferbam, Coromate
ziram	Zerlate, Karbam White, Corozate, Ziram
nabam	Dithane D-14 (liquid), Parzate (liquid) Thiodow, Nabam
zineb	Dithane Z-78, Parzate, Zineb, Lonacol
thiram	Arasan, Panoram, Tersan, Thiram, Thylate
captan	Orthocide, Captan 50-W
glyodin	Glyoxide, Glyodin
dichlone	Phygon, Phygon XL
maneb	Manzate D, Dithane M-22 Special, Maneb
dodine	Cyprex, Melprex
folpet	Phaltan, Folpet
DCNA	Botran
dinocap	Karathane, Capryl

The following *examples* may help simplify the usage of "common names" for active fungicidal chemicals in active ingredient statements used on labeling:

<u>Trade Name</u>	<u>Active Fungicidal Chemical</u>	<u>Common Name for Active Fungicidal Chemical</u>
Fermate	76% ferric dimethyl dithiocarbamate	76% ferbam

The concentrate material containing 76% ferbam is used in preparing spray mixtures, i.e., 2 lb., 76% ferbam to 100 gal. of spray mixture for certain applications in Bunch Grape Spray Program pg. 68.

For dust application, 100 lb. of a dust formulation containing 11.4% ferbam, as used for Tobacco Blue Mold Control, pg. 86, can be formulated by mixing 15 lb. of 76% ferbam with 85 lb. of an inactive diluent.

Note: The above examples do not infer endorsement for Fermate. Numerous trade name formulations containing various percentages of ferbam and for many uses are available.

PRECAUTIONS AND ANTIDOTES

Mercury compounds:

Mercury compounds are poisonous and should be handled with care. Avoid inhaling vapors and contact with eyes and skin. In case of poisoning by swallowing, give raw eggs or milk immediately, then a tablespoon of salt in a glass of warm water and repeat until vomit fluid is clear. In case of contact, remove all contaminated clothing and flush skin or eyes with plenty of water. Keep material away from small children and animals.

Soil fumigants:

Fumigants containing either dichloropropene (D-D, Telone) or ethylene dibromide (Dowfume W-85, Soilfume 85, Dowfume W-40, Soilfume 40) or mixture of these materials (Dorlone, Field Fume) Vorlex, or materials containing 1-2 dibromo-3-chloropropane are toxic to humans and animals, but with proper handling they can be used without risk. The vapors of these materials have sufficient odor to give warning of their presence. Avoid prolonged breathing of the vapors. Prolonged inhalation may cause difficulty in breathing. If this occurs, call a physician and remain quiet. Avoid contact with the skin. These fumigants may cause inflammation, burns and even blisters if left in contact with the skin too long. Affected areas should be washed thoroughly with soap and water. If contact results

in a persistent redness of the skin, a physician should be consulted. Contaminated shoes and clothing should not be worn until it is certain they are free of all of these chemicals. Affected leather shoes are difficult to clean and should be destroyed. Prevent splashing of the fumigants in the eyes by wearing goggles when pouring these materials. If the eyes are accidentally contaminated, they should be flushed with flowing water for at least 15 minutes and then consult a physician. Never attempt to siphon fumigants by mouth suction since swallowing the materials may have serious consequence. If the fumigants are accidentally swallowed, produce vomiting (take a tablespoonful of salt in a glass of warm water or drink soapy water). Repeat until vomit fluid is clear. Call a physician and remain still and quiet. D-D and ethylene dibromide are toxic to living plants. Avoid using near living plants or planting too soon after fumigation.

Methyl bromide and chloropicrin are dangerous chemicals and special precautions should be taken when using them. They are harmful by inhalation of vapors, by prolonged or repeated contact with the skin and by oral intake. Injuries from methyl bromide and chloropicrin can be prevented by following a few simple rules. When using these chemicals, always make sure that ventilation is adequate. Do not breathe the vapors. When removing cover from plant bed or dispensing the gas, have the wind at your back, if possible, so the vapors will be blown away from you. If a person is overcome by vapors, he should be removed immediately to fresh air. If breathing has stopped, use artificial respiration. Keep the patient quiet and get medical attention immediately.

If the chemicals are spilled on clothing or shoes, remove immediately and air thoroughly before reuse. If spilled on skin, wash the affected area immediately with soap and water, otherwise severe blistering will occur. Direct contact of liquid methyl bromide with the eye or eyelids may cause serious injury to either or both. If the eyes are accidentally contaminated, they should be flushed with flowing water for at least 15 minutes and then consult a physician. (Methyl bromide is packed under pressure so *do not* use an ordinary can opener to open the can—special equipment is available for this.)

Note: Listings of chemicals and trade names are based on results with one or more commercial sources of the listed active ingredients. Testing of all commercial formulations is not implied.

READ THE DIRECTIONS ON THE LABEL
AND FOLLOW THEM AT ALL TIMES

HOW TO COLLECT, PREPARE AND SHIP PLANT MATERIAL FOR DISEASE IDENTIFICATION

ROBERT AYCOCK, H. R. GARRISS, J. C. WELLS

Many of the 3,000 or more plant disease specimens submitted annually to the Plant Disease Clinic arrive in such poor condition that proper handling is difficult. Unidentified specimens, those completely desiccated or in advanced states of decay, and those which arrive without necessary information may have to be discarded. This represents time and labor wasted for the sender and personnel at the Clinic. Close attention to the following points will insure better service.

Destination of Specimens

1. The Plant Disease Clinic (Box 5397, State College Station, Raleigh, N. C.) attempts primarily to diagnose troubles of a parasitic nature; i.e., those caused by fungi, bacteria, viruses and nematodes.
2. The Clinic does not diagnose 1) insect injury, 2) fertility problems or 3) chemical injury. Plants suspected of being in any of these categories should be referred directly to the Extension Specialist in the appropriate department.
3. Soil samples for chemical analyses are processed by the N. C. Soil Testing Division, N. C. Department of Agriculture and should not be sent to the Plant Disease Clinic.

Collecting:

Plants showing wilting, yellowing or general decline:

1. Send whole plants including roots if practicable. *Be sure to send plants showing early stages.*
2. Dig up carefully (*don't pull up*).
3. Send sample of soil and feeder roots in plastic bag, sealed to avoid loss of moisture.

Cankers:

1. Select specimens from recent infections.
Send entire cankered portion, if possible, with some of the healthy wood above and below the canker.
3. Branches and twigs that have been dead for several months are useless for identification.

Leaf Spots:

1. Collect leaves showing early and late stages of infection.
2. It is usually not possible to diagnose leaves which show marginal burning or other injury symptoms.

Fleshy organs:

1. Rots of fleshy fruits & vegetables need special attention. Do not send those in advanced stages of decay.
2. Select fresh specimens showing early symptoms.

PLACE SPECIMENS IN PLASTIC BAG OR WRAP IMMEDIATELY IN FOIL OR SARAN. FLESHY VEGETABLES AND FRUIT SPECIMENS SHOULD BE WRAPPED SEPARATELY. DO NOT ADD EXTRA MOISTURE. KEEP COOL UNTIL SHIPPED.

Packaging and Mailing

1. Wrap package in heavy paper. Take care not to overcrowd or crush plants.
2. Pack in sturdy container to prevent crushing in transit.
3. Identify package with both outside and inside labels; don't put inside label in contact with moisture.
4. Address package to Plant Disease Clinic, Box 5397, State College Station, Raleigh, N. C.
5. Mail packages to arrive on week days (Monday through Friday) rather than during weekend.

Information With The Specimen

Describe symptoms with which you are most concerned and give tentative diagnosis if one has been made.

Describe the appearance of the disease in the field, stating whether occasional plants, scattered small areas, large areas, or whole fields are affected. Include information on cropping sequence, seed treatment, date of planting, and fertilizers, soil fumigants, herbicides, and dusts or sprays used.

Note: Findings reported by the PLANT DISEASE CLINIC are necessarily based on examination of the material submitted. Some diagnoses require intensive microscopic and biochemical studies. Since the time devoted to routine individual specimens must necessarily be limited, clinic reports, while reflecting considered opinion and best judgment, may not always be statements of established fact. Moreover, it is not always possible to determine the specific source of infection when infectious diseases are present.

Diagnoses of insect damage or injuries caused by insecticides or herbicides are outside the area of responsibility of the Plant Disease Clinic. Specimens suspected to have such injuries should be sent to the appropriate department.

PUBLICATIONS DEALING WITH PLANT DISEASE CONTROL

More detailed information than space allows in this manual is usually needed for best use of chemicals for the control of plant diseases. In addition, information on other practices which will either supplement chemical treatments or is valuable in disease control where chemicals cannot be used successfully, is highly desirable. The following publications dealing with various phases of plant disease control are available from the *Plant Pathology Extension Office, N. C. State, Raleigh.*

Tobacco

- Tobacco Blue Mold and Anthracnose Control—Ext. Cir. No. 397
- Experiments on Tobacco Blue Mold Control—Exp. Sta. Tech. Bul. No. 111
- Mosaic Control in Tobacco—Ext. Folder No. 128
- Wildfire Control in Burley Tobacco—Ext. Cir. No. 401
- Sore Shin and Southern Stem Rot of Tobacco—Ext. Folder No. 140
- Brown Spot of Tobacco—Ext. Folder No. 139
- Tobacco Plant Production Guide—(Revised) Ext. Cir. No. 363
- Stem Rot of Tobacco—Plant Pathology Inf. Note No. 6
- Black Shank of Tobacco—Ext. Folder No. 161
- Lightning Injury of Tobacco—Plant Pathology Inf. Note No. 12
- Cropping Systems for Nematode Control and Tobacco Production. Ext. Cir. No. 409
- Planning a Nematode Control Program for Flue Cured Tobacco—Plant Pathology Inf. Note No. 64
- Weather Fleck or Physiological Leafspot of Tobacco—Plant Pathology Inf. Note No. 79
- Kill weeds & Nematodes In Tobacco Plant Beds—Ext. Cir. 427 (Rev.)
- Soil Fumigation for Nematode In Tobacco—Ext. Folder 236
- Reduce 6 Pest Ext. Misc. Publication 10A

Peanuts

- Peanut Nematode Diseases—Ext. Folder No. 136
- Peanut Production Guide—Ext. Cir. No. 257
- Southern Stem Rot of Peanuts—Plant Pathology Inf. Note No. 26
- Peanut Disease Control—Plant Pathology Inf. Note No. 116
- Pod Rot Control Plant Pathology Inf. Note 149

Cotton

- Cotton Diseases—How to Recognize and Control Them—Reprint Cotton Gin and Oil Mill Press, April, 1953.
- In-Row Fungicides in Cotton Seedling Disease Control—Plant Pathology Information Note No. 89
- Soil Fumigation for Nematode Control in Cotton—Plant Pathology Information Note No. 102
- Cotton Diseases and Their Control, Cotton Disease Council and National Cotton Council Dec., 1964

Small Grain

- Small Grain Diseases—Ext. Cir. No. 347
Mosaic Disease of Wheat—Plant Pathology Inf. Note No. 25
Brown Loose Smut of Barley—Ext. Folder No. 132
The Yellow Dwarf Disease of Small Grains—Plant Pathology Inf. Note No. 59

Soybeans

- Producing Soybeans in North Carolina—Ext. Cir. No. 381-61 (Rev.)
Some Important Diseases of Soybeans in N. C.—Plant Pathology Inf. Note 74

Vegetable Crops

- Cabbage Production Guide—Ext. Folder No. 89
Cucurbit Diseases in North Carolina and Their Control—Ext. Circ. 446
Tomato Wilt Diseases—Ext. Folder No. 92 (Rev.)
Pepper Diseases in North Carolina and Their Control—Ext. Cir. No. 418
Grow Quality Sweet Potatoes—Ext. Cir. No. 353 (revised)
Major Corn Diseases in North Carolina—Ext. Cir. 408
Some Important Diseases of Vegetable Crops in North Carolina—Plant Pathology Inf. Note No. 24
Leafspot Diseases of Turnip-Greens—Plant Pathology Inf. Note No. 11 (Rev.)
Vegetable Plant Production—Ext. Cir. No. 231
Tomato Disease Control—Plant Pathology Inf. Note No. 90
Control Root Knot in the Vegetable Garden—(revised) Ext. Cir. No. 337
Home Garden Disease Control—Plant Pathology Inf. Note No. 44 (Rev.)
Late Blight of Tomato—Plant Pathology Inf. No. 65
Blossom End Rot—Plant Pathology Inf. No. 66
Nailhead Spot of Tomato—Plant Pathology Inf. No. 67
Virus Diseases of Tomato—Plant Pathology Inf. No. 68
Damping Off—Plant Pathology Inf. No. 69
Anthracnose of Tomato—Plant Pathology Inf. No. 70
Bacterial Spot of Tomato—Plant Pathology Inf. No. 71
Stemphylium or Gray Leaf Spot of Tomato—Plant Pathology Inf. No. 72
Early Blight of Tomato—Plant Pathology Inf. No. 73
Botrytis Blight of Tomato—Plant Pathology Inf. Note No. 94
Scurf—Scourge of Sweet Potato Production—Plant Pathology Information Note No. 103
Tomato Leaf Mold—Plant Pathology Inf. Note No. 115
Botrytis Blight in Pepper Plant Beds—Plant Pathology Inf. Note No. 118
Corn virus disease problem, Plant Pathology Inf. Note No. 124
Garden Vegetable Seed Dem. Results, Plant Pathology Inc. Note No. 127
Bacterial Canker of Tomato, Plant Pathology Inf. Note No. 130
Disease Control for Trellised Cucumbers, Plant Pathology Inf. Note No. 144

Forage Crops

- Forage Crop Diseases—Ext. Cir. No. 361 (Rev.)
Annual Lespedezas in North Carolina—Ext. Cir. No. 387
Stem Nematode of Alfalfa—Ext. Folder No. 113
Grain Sorghum (Milo) Disease Control—Plant Pathology Inf. Note 50

Fruits and Small Fruits

Apple Spray Information

- Three Rust Diseases of Apple—Plant Pathology Inf. Note No. 33
Fire Blight of Apple and Pear—Plant Pathology Inf. Note No. 28
Spray Program for Bunch Grapes in North Carolina—Plant Pathology Inf. Note No. 126
Black Knot of Plum and Cherry—Plant Pathology Inf. Note No. 20
Commercial Strawberry Production—Ext. Cir. No. 422
Peach Disease and Insect Control—Ext. Cir. 407 (Rev.)
Red Stele Disease of Strawberry in North Carolina—Plant Pathology Inf. Note No. 46
Raspberry and Dewberry Disease Control—Plant Pathology Inf. Note No. 32
Strawberry Disease Control—Plant Pathology Inf. Note No. 54
Gray Mold Rot of Strawberry—Plant Pathology Inf. Note No. 48
Blueberry Disease and Insect Control—Plant Pathology Inf. No. 125
Home Fruit Sprays For Insect & Disease Control—Plant Pathology Inf. Note No. 91
Spray Program for Processing Apples—Plant Pathology Inf. Note No. 135
Stem Canker & Related Blueberry Diseases—Tech. Bull. 132
Muscadine Grape Disease Control—Plant Pathology Inf. Note No. 145
Blueberry Diseases in N. C.—Ext. Circ. 466

Ornamentals

- Azaleas and Camellias—Ext. Folder No. 185
Spot Anthracnose of Flowering Dogwood—Ext. Folder No. 150
Lawn Disease Control—Ext. Folder No. 135 Revised
Hemlock Twig Rust in North Carolina—Ext. Folder No. 172
Nematode Control in Woody Ornamentals—Plant Pathology Inf. Note No. 63
Dutch Elm Disease—Plant Pathology Information Note No. 95
Diseases of Narcissus in North Carolina—Plant Pathology Information Note No. 105
Commercial Production of Gladioli in N. C.—Ext. Circ. 448
Diseases of Gladioli in N. C.—Plant Pathology Inf. Note No. 108
Diseases of Chrysanthemum in N. C.—Plant Pathology Inf. Note No. 109
Diseases of Iris in N. C.—Plant Pathology Inf. Note No. 110
Diseases of Annual Larkspur in N. C.—Plant Pathology Inf. Note No. 111
Diseases of Carnations in N. C.—Plant Pathology Inf. Note No. 112
Diseases of Snapdragons in N. C.—Plant Pathology Inf. Note No. 113
Hot Water Treatment of Gladiolus Cormels in N. C., Plant Pathology Inf. Note No. 120
Disease Control in Roses—Plant Pathology Inf. Note 129

Miscellaneous

- Wood Decay in Buildings—Plant Pathology Inf. Note No. 55
Nemagon & Fumazone Soil Fumigant Conversion Table—Plant Pathology Inf. Note No. 88
Chemicals for control of plant disease, Plant Pathology Inf. Note No. 119
Vorlex treatment for plastic greenhouses, Plant Pathology Inf. Note No. 131
Pecan Scab—Plant Pathology Inf. Note No. 139

PESTICIDES ARE A NECESSITY—USE THEM PROPERLY

FRUIT

Apple Spray Program

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H. R. GARRIS, Plant Pathology Extension

G. C. ROCK, Entomology Research
G. T. WEEKMAN, Entomology Extension

Number & Time of Application	Amounts of Fungicide and Insecticide Per 100 Gallons of Water
PRE-BLOOM SPRAYS	
FIRST SPRAY Green-Tip Stage When buds show ¼ inch new growth	FUNGICIDE: dodine 65% WP (Cyprex) ½ lb. OR sulfur WP 3 lb. + ferbam 76% WP ½ lb. + dichlone 50% WP (Phygon XL) ¼ lb. OR sulfur WP 3 lb. + ferbam 76% WP ½ lb. + dodine 65% WP ½ lb. Dodine is effective against scab; ferbam against rusts; sulfur against mildew.
SECOND SPRAY Half-inch green stage When buds show ½ inch new growth	FUNGICIDE: dodine 65% WP (Cyprex) ½ lb. INSECTICIDE: oil 70-second superior type, 2 gal. Important spray for mite eggs.
THIRD SPRAY One week after SECOND SPRAY if needed for scab control	FUNGICIDE: Use same fungicide as selected for FIRST SPRAY .
FOURTH SPRAY Pink stage When blossom buds in cluster pink, stems extended	FUNGICIDE: Use same fungicide as selected for FIRST SPRAY OR captan 50% WP 2 lb. INSECTICIDE: demeton 26% EC (Systox) ¼ pt. OR dimethoate 2.67 EC (Cygon) ¾ pt.
BLOOM SPRAY Omit fungicide if PETAL-FALL SPRAY will be applied within 12 days of FOURTH SPRAY .	FUNGICIDE: dodine 65% WP (Cyprex) ½ lb. + ferbam 76% WP ½ lb. OR captan 50% WP 2 lb. DO NOT spray in peak of bloom. On Rome Beauty add sulfur WP 3 lb. for mildew control. FOR FIRE BLIGHT CONTROL: Use streptomycin WP at 60-100 parts per million in sprays at 5-day intervals from the start to the end of bloom. INSECTICIDE: DO NOT USE an insecticide in BLOOM SPRAY .
PETAL-FALL SPRAY When most petals have fallen	FUNGICIDE: captan 50% WP 2 lb. OR folpet 50% WP (Phaltan) 2 lb. If needed for RUST control, include ferbam 76% WP ½ lb. OR thiram 65% WP (Thylate) ½ lb. If needed for mildew control, include sulfur WP 1½ lb. OR dinocap 25% WP (Karathane) ¼ lb. INSECTICIDE: lead arsenate WP 3 lb. + demeton 26% EC (Syston) ¾ pt. OR dimethoate 2.67 EC (Cygon) ¾ pt.
COVER SPRAYS	
FIRST COVER 8-10 days after PETAL-FALL SPRAY	FUNGICIDE: Same as in PETAL-FALL SPRAY . INSECTICIDE: azinphosmethyl 50% WP (Guthion) ½ lb.
SECOND COVER 12 to 14 days later	FUNGICIDE: captan 50% WP 2 lb. OR folpet 50% WP (Phaltan) 2 lb. INSECTICIDE: azinphosmethyl 50% WP (Guthion) ½ lb. OR lead arsenate WP 3 lb.

APPLE SPRAY PROGRAM (Continued)

THIRD COVER 2 weeks later	FUNGICIDE: captan 50% WP 2 lb. OR folpet 50% WP (Phaltan) 2 lb. INSECTICIDE: azinphosmethyl 50% WP (Guthion) $\frac{1}{2}$ lb. OR lead arsenate WP 3 lb. MITICIDE: Morestan 25% WP $\frac{1}{4}$ lb. OR dicofol 35% EC (Kelthane) 1 pt. OR tetradifon 25% WP (Tedion) 1 lb. OR chloropropylate 25% EC (Acaralate) 1 qt. Morestan may russet Golden Delicious.
SPECIAL MITE SPRAY 1 week later	MITICIDE: Use same miticide as in THIRD COVER.
FOURTH COVER 2 weeks after third cover	FUNGICIDE: captan 50% WP 2 lb. OR folpet 50% WP 2 lb. INSECTICIDE: azinphosmethyl 50% WP (Guthion) $\frac{1}{2}$ lb.
FIFTH COVER 2 weeks later	FUNGICIDE: captan 50% WP 2 lb. OR folpet 50% WP 2 lb. OR substitute captan 50% WP 1 lb. + zineb 75% WP 1 lb. for captan 50% WP 2 lb. INSECTICIDE: azinphosmethyl 50% WP (Guthion) $\frac{1}{2}$ lb. OR lead arsenate WP 3 lb. Do not use lead arsenate within 30 days of harvest.
SIXTH COVER 2 weeks later	FUNGICIDE: captan 50% WP 2 lb. OR folpet 50% WP 2 lb. or captan 50% WP 1 lb. + zineb. 75% WP 1 lb. INSECTICIDE: azinphosmethyl 50% WP (Guthion) $\frac{1}{2}$ lb. OR parathion 15% WP 2 lb. OR malathion 25% WP 2 $\frac{1}{2}$ lb. OR carbaryl 50% WP (Sevin) 2 lb.
SEVENTH COVER 2 weeks later	FUNGICIDE: captan 50% WP 2 lb. OR folpet 50% WP 2 lb. or captan 50% WP 1 lb. + zineb. 75% WP 1 lb. INSECTICIDE: azinphosmethyl 50% WP (Guthion) $\frac{1}{2}$ lb. or parathion 15% WP 2 lb. OR malathion 25% WP 2 $\frac{1}{2}$ lb. OR carbaryl 50% WP 2 lb.

EC = Emulsifiable concentrate

WP = Wettable Powder

G = Granular

Another spray after the SEVENTH COVER may be required. Keep Red Delicious and Golden Delicious trees sprayed until a month of harvest and Stayman and Rome Beauty trees until 6 weeks of harvest with same materials as used in SEVENTH COVER.

TIME LIMITATION IN DAYS TO HARVEST: azinphosmethyl (Guthion) 15; captan, 0; carbaryl (Sevin) 1; demeton (Systox), 21; dichlone (Phygon XL), 1; dicofol (Kelthane), 7; dimethoate (Cygon), 28; dinocap (Karathane), 21; dodine (Cyprex), 7; ferbam, 7; folpet (Phaltan), 0; lead arsenate, 30; malathion 3; Morestan, 35; parathion, 14; tetradifon (Tedion), 4 times per season; thiram (Thylate), 0; zineb, 0; chloropropylate (Acaralate) 14, maneb, 7.

PEACH SPRAY PROGRAM

C. N. CLAYTON, Plant Pathology Research

C. F. SMITH, Entomology Research

G. T. WEEKMAN, Entomology Extension

Name and Time	Materials	Pests Controlled and Remarks
DORMANT After all leaves are off and before buds begin to swell in late winter	FUNGICIDE: Liquid lime-sulfur 6 gal. OR Bordeaux 6-6-100 OR Ferbam 75% WP 2 lb.	Leaf curl, San Jose and Forbes scales. When there is a scale infestation, liquid lime sulfur at the rate of 12 gallons or 3% oil may be used as the dormant spray. To control white peach scale, two dormant oil sprays two weeks apart are necessary. Leaf curl is controlled by a dormant application of lime-sulfur OR ferbam OR Bordeaux. Under severe leaf curl conditions use 12 gallons of liquid lime-sulfur.
BLOSSOM	FUNGICIDE: Wettable sulfur 6 lb. OR Wettable sulfur 6 lb. OR Dichlone 50% WP (Phygon XL) ½ lb.	Blossom blight caused by the brown rot fungus. Several sprays applied during bloom may aid in reducing blossom blight. Sulfurs with less than 80% sulfur content may be used at rates to give at least 5 pounds of actual sulfur in 100 gallons.
PETAL-FALL After all petals are off and before peach is showing	FUNGICIDE: Wettable sulfur 6 lb. OR Captan 50% WP 2 lb. INSECTICIDE: Parathion 15% WP 2 lb. OR Azinphosmethyl 50% WP (Guthion) ½ lb. OR Dieldrin 50% WP	Brown rot, plum curculio, catfacing insects. If captan is not used throughout the season, wait until 6 weeks before harvest before substituting it for sulfur (especially important where scab was severe the year before). Doline (Cyprex) may be used, but be applied under ideal drying conditions or damage to fruit and foliage may result. If catfacing insects are a problem use azinphosmethyl or arelarin.
SHUCK-FALL OR FIRST COVER ¼ shuck off	FUNGICIDE: Same as in PETAL-FALL INSECTICIDE: Same as in PETAL-FALL	Brown rot, scab, plum curculio, catfacing insects. Spray trunks and larger limbs thoroughly during each cover spray to aid in control of peach tree borers.
SECOND COVER 7-10 days later	FUNGICIDE: Wettable sulfur 6 lb. OR Captan 50% WP 2 lb. INSECTICIDE: Parathion 15% WP 2 lb. OR Azinphosmethyl 50% WP (Guthion) ½ lb. OR Malathion 75% WP 4 lb.	Brown rot, scab, plum curculio. This cover spray is very important for the control of these pests.

PEACH SPRAY PROGRAM (Continued)

THIRD COVER 12-14 days later	FUNGICIDE: Same as in SECOND COVER INSECTICIDE: Same as in SECOND COVER	Brown rot, scab, plum curculio.
FOURTH COVER 14 days after THIRD COVER	FUNGICIDE: Wettable sulfur 6 lb. OR Captan 50% WP 2 lb.	Brown rot, scab.
SIX WEEKS BEFORE HARVEST of each variety	FUNGICIDE: Same as SECOND COVER INSECTICIDE: Same as SECOND COVER	Brown rot, scab, plum curculio, oriental fruit moth.
FOUR WEEKS BEFORE HARVEST of each variety	FUNGICIDE: Same as in SECOND COVER INSECTICIDE: Same as in SECOND COVER	Brown rot, scab, plum curculio, oriental fruit moth.
TWO WEEKS BEFORE HARVEST of each variety	FUNGICIDE: Wettable sulfur 6 lb. OR Captan 50% WP 2 lb. OR Captan 50% WP 1 lb. + Botran 75% WP 1 lb. INSECTICIDE: Parathion 15% WP 2 lb. OR Malathion 25% WP 4 lb.	Brown rot, plum curculio, oriental fruit moth, rhizopus rot use a Botran-captan.
PRE-HARVEST 7 days and again 1 day before harvest of each variety	FUNGICIDE: Same as in last spray OR Sulfur Dust OR Captan Dust	Brown rot, plum curculio, oriental fruit moth. Additional sulfur OR captan, preferably as dust, should be applied before and during harvest if brown rot is present or rainy, humid weather occurs. Carbaryl 50% WP (Sevin) 2 lb. may be used if oriental fruit moth or green June beetles are a problem within 1 day of harvest. For rhizopus rot control, use the Botran-captan mixture. Pre-harvest Botran sprays are of little value if peaches are subjected to dirty hydrocooling water.

PEACH TREE BORER

A single application of endosulfan 50% WP (Thiodan) at the rate of 5 lb. per 100 gallons before peaches are visible, after harvest, or after August 1, whichever comes last. Best control is obtained when applied the week of Sept. 1.

TIME LIMITATIONS IN DAYS TO HARVEST: carbaryl (Sevin), 1; azinphosmethyl (Guthion), 21; parathion, 14; Botron, 1; captan, 0; ferbam 21; dichlone (Phygon XL), 7.

BLUEBERRY SPRAY PROGRAM

R. D. MILHOLLAND, Plant Pathology Research

H. H. NEUNZIG, Entomology Research

G. T. WEEKMAN, Entomology Extension

When to Spray	Materials to Use in 100 Gallons Water
Before new growth starts	For scales use oil 70-second Superior type, 2 to 3 gal.
Just after bloom	For plum curculio, cranberry fruitworm, cherry fruitworm, leaf spots use parathion* 15% WP 1½ lb. OR malathion 25% WP 4 lb. OR carbaryl 80% WP (Sevin) 1 lb. + ferbam 76% WP 2 lb. OR dyrene 50% WP 2 lb.
7 to 10 days after bloom is complete	Same as above.
When first berries turn blue and every 7 to 10 days during harvest.	For blueberry maggot use malathion 25% WP 2 lb. Do not spray on day blueberries will be harvested.
After all berries are harvested	For leafhoppers, leaf spots, use same as in just after bloom.
2 weeks after bloom is complete	For blueberry budmite (1) (2), leaf spots use endosulfan 25% EC (Thiodan) 1 qt. OR ethion .67 oil 2 gal. OR oil 70-second Superior type 2 gal. + ferbam 76% WP 2 lb. OR dyrene 50% WP 2 lb.
4 weeks after harvest is complete	For leaf hoppers, leaf spots use same as in just after bloom.
6 weeks after harvest is complete	For blueberry bud mite, leaf spots use same as 2 weeks past bloom spray.

WP = Wettable powder

* Parathion should be applied only by trained personnel.

(1) To get adequate penetration and coverage, use 200 lb. pressure and from 200 to 400 gal. of water per acre depending on plant size.

(2) Add ferbam or dyrene to water in spray tank and mix before adding oil.

TIME LIMITATIONS IN DAYS TO HARVEST: carbaryl (Sevin), 0; malathion, 1; parathion, 14; dyrene, 14; ferbam, 40; endosulfan (Thiodan), not after buds are well formed.

BUNCH GRAPE SPRAY PROGRAM

C. N. CLAYTON, Plant Pathology

H. R. GARRIS, Plant Pathology Extension

G. T. WEEKMAN, Entomology Extension

When to Spray	Spray Materials to Use			Diseases and Insects	Remarks		
	In 100 Gal. Water	In 3 Gal. Water					
DORMANT (before buds open)	FUNGICIDE: Copper sulfate (bluestone) OR Liquid lime-sulfur OR Dry lime-sulfur	8 lb. 10 gal. 30 lb.	4 oz. 1 lb.	Anthracnose	For scale control use 2% superior type oil 2 weeks prior to lime-sulfur or copper sulfate spray.		
	1. When new shoots are 1 to 2 in.	FUNGICIDE: Ferbam 76% WP OR Maneb 80% WP OR Zineb 75% WP OR Captan 50% WP OR Bordeaux mixture	2 lb. 2 lb. 2 lb. 2 lb.			1 oz. 1 oz. 1 oz. 1 oz.	Blackrot Anthracnose Dead arm

BUNCH GRAPE SPRAY PROGRAM (Continued)

2. When new shoots are 7 to 8 in.	FUNGICIDE: Same as in Spray No. 1 INSECTICIDE: Carbaryl 50% WP (Sevin)	2 lb.	1 oz.	Blackrot Anthracnose Mildews Flea beetles	
3. Just before blossoms open.	FUNGICIDE: Same as in Spray No. 1 INSECTICIDE: Azinphosmethyl 50% WP (Guthion) OR Carbaryl 50% WP (Sevin) OR Parathion 15% WP OR Malathion 25% WP	1 lb. 2 lb. 1½ lb. 4 lb.	½ oz. 1 oz. 1 oz. 2 oz.	Blackrot Anthracnose Mildews Berry moth Leafhoppers Flea beetle Aphids	Parathion and azinphosmethyl are extremely toxic materials. Label precautions should be followed in their use.
4. Just after bloom.	FUNGICIDE: Same as in Spray No. 3 INSECTICIDE: Same as in Spray No. 3				
5. About 10 days later.	FUNGICIDE: Same as in Spray No. 3 INSECTICIDE: Same as in Spray No. 3				
6. 2 weeks later.	FUNGICIDE: Ferbam 75% WP OR Maneb 80% WP OR Zineb 75% WP OR Captan 50% WP INSECTICIDE: Azinphosmethyl 50% WP (Guthion) OR Carbaryl 50% WP (Sevin) OR Parathion 15% WP OR Malathion 25% WP	2 lb. 2 lb. 2 lb. 2 lb. 1 lb. 2 lb. 1½ lb. 4 lb.	1 oz. 1 oz. 1 oz. 1 oz. ½ oz. 1 oz. 1 oz. 2 oz.	Blackrot Midews Berry moth Leafhoppers Aphids Japanese beetle June beetle	
7. 2 weeks later.	FUNGICIDE: Same as in Spray No. 6 INSECTICIDE: Same as in Spray No. 6			Same as above + Bitter rot Ripe rot	
8. 2 weeks later.	FUNGICIDE: Captan 50% WP INSECTICIDE: Azinphosmethyl 50% WP (Guthion) OR Carbaryl 50% WP (Sevin) OR Malathion 25% WP	2 lb. 1 lb. 2 lb. 4 lb.	1 oz. ½ oz. 1 oz. 1 oz.	Same as above	
9. 2 weeks later.	FUNGICIDE: Same as in Spray No. 8 INSECTICIDE: Same as in Spray No. 8			Same as above	

WP = Wettable powder

TIME LIMITATIONS IN DAYS BETWEEN LAST SPRAY AND HARVEST: captan, 0; ferbam, 7; malathion, 3; maneb, 7; parathion, 14; carbaryl (Sevin), 0; zineb, 7; azinphosmethyl (Guthion), 10.

PECAN SPRAY PROGRAM

R. L. ROBERTSON, Entomology Extension

H. R. GARRISS, Plant Pathology Extension

When to Spray	Pests to Control and Material to Use in 100 Gallons of Water
FIRST PREPOLLINATION When buds are bursting and first leaves are showing	For scab use dodine 65% WP (Cyprex) $\frac{3}{4}$ lb. Apply only when temperature is above 55° F. ¹
SECOND PREPOLLINATION When leaves are $\frac{1}{2}$ grown	For scab use same as above. Complete coverage of entire tree is essential.
FIRST COVER —When young nuts first appear	For scab, nut casebearer, leaf casebearer, mites use dodine 65% WP (Cyprex) 1 lb. + Parathion 15% WP 2 lbs. OR malathion 25% WP 4 lb. OR azinphosmethyl 50% WP (Guthion) $\frac{1}{2}$ lb.
SECOND COVER —two weeks after first cover	For scab + insects listed above use same as above. If powdery mildew is a problem use sulfur WP 3 lb.
THIRD COVER —two to three weeks after second cover	For scab use dodine 65% WP (Cyprex) $\frac{3}{4}$ lb.
FOURTH COVER —two to three weeks after third cover	For scab, aphids, mites, shuckworms, pecan weevil use dodine (Cyprex) as above + EPN 25% EC 1 qt.
FIFTH COVER —three weeks after fourth cover	Same as above. If EPN fails to control mites add demeton 26% EC (Systox) 1 pt.
SIXTH COVER —three weeks after fifth cover	For scab, aphids, use dodine (Cyprex) as above + parathion as in first cover. If dry weather prevails and aphid infestations are heavy, additional parathion applications may be needed.

EC = Emulsifiable Concentrate

WP = Wettable Powder

¹ On scab resistant varieties such as Stuart, dodine (Cyprex) is needed only in 3rd cover spray. Use insecticides listed in First, Second, Fourth, and Sixth cover sprays.

CAUTION: Parathion, EPN, azinphosmethyl (Guthion) and demeton (Systox) are extremely toxic and should be used only by trained operators who will observe all safety precautions listed on the labels.

KEEP PESTICIDES IN PROPERLY LABELED CONTAINERS

BRAMBLE SPRAY PROGRAM

H. R. GARRISS, Plant Pathology Extension

C. N. CLAYTON, Plant Pathology Research

G. T. WEEKMAN, Entomology Extension

Raspberry	When to Spray		Material (1) (2)	Amount to Use	
	Dewberry			For 2½ gal.	For 100 gal.
In late winter or early spring when new growth is less than ½ inch long.	In late winter or early spring just after the canes are tied up and before new growth is ½ inch long.		FUNGICIDE: Liquid lime-sulfur OR Dry lime-sulfur OR Bordeaux	1 qt. 12 oz. 6 oz.	10 gal. 30 lb. 16 lb.
Just before first blooms open.	Just before first blooms open.		FUNGICIDE: Ferbam 76% WP INSECTICIDE: Azinphosmethyl 50% WP (Guthion) OR malathion 25% WP	6 tbsp. 3 tbsp. 6 tbsp.	2 lb. 1 lb. 2 lb.
Apply when new canes are 1½ to 2 feet long.	Just after bloom.		FUNGICIDE: Ferbam 76% WP INSECTICIDE: Azinphosmethyl 50% WP (Guthion) OR Malathion 25% WP OR Carbaryl 50% WP (Sevin)	6 tbsp. 3 tbsp. 6 tbsp. 6 tbsp.	2 lb. 1 lb. 2 lb. 2 lb.
Just after harvest.	After harvest and when new growth is about 1 to 1½ feet long.		FUNGICIDE: Ferbam 76% WP INSECTICIDE: Azinphosmethyl 50% WP (Guthion) OR Malathion 25% WP OR Carbaryl 50% WP (Sevin)	6 tbsp. 3 tbsp. 6 tbsp. 6 tbsp.	2 lb. 1 lb. 2 lb. 2 lb.

(1) See Plant Pathology Information Note No. 22 for further information on disease control.

(2) Spray plants thoroughly, to insure proper wetting of canes and leaves use a commercial spreader-sticker at the rate of 2 to 3 ounces per 100 gallons of spray.

TIME LIMITATIONS IN DAYS BETWEEN LAST SPRAY AND HARVEST: azinphosmethyl (Guthion), 14; carbaryl (Sevin), 7; malathion, 1; ferbam, 40; liquid lime-sulfur, lime-sulfur, Bordeaux, no limitation.

SOIL FUMIGANTS FOR NEMATODE CONTROL IN COTTON

H. R. GARRISS & W. E. COOPER

Trade Name (List may not be complete)	Active Ingredient	Time of application & dosage per acre	
		Pre-plant	
		Row	Broadcast
Nemagon Fumazone	1, 2-dibromo-3 chloropropane	½ gal. active	1½ gal. active
D-D Oma-D Vidden-D, etc.	dichloropropene dichloropropane- mixture	10 gal. product	20 gal. product
Telone	dichloropropene	8 gal. product	16 gal. product
Dowfume W-40 Soilfume 40	ethylene dibromide*	9 gal. product	18 gal. product
Dowfume W-85 Soilfume 85		2¼ gal. product	4½ gal. product
Dorlone		dichloropropene plus ethylene dibromide	
Oma Fume D-EDB	dichloropropene- dichloropropane mixture plus ethylene dibromide	6 gal. product	12 gal. product
Thimet-Zinophos 15 PTG ¹	phorate plus 0,0 diethyl 0-2- pyrazinyl phosphorothioate*	10 lb./A. in row immediately ahead of planting or during planting operation if equipped.	

¹ May cause slight delay in maturity. Follow good boll weevil and bollworm control program. Do not use additional systemic insecticide—will control early season thrips, aphids and mites.

* Preferable where sting nematodes are a major problem.

IN-ROW FUNGICIDES FOR SEEDLING DISEASE CONTROL IN COTTON

H. R. GARRISS & W. E. COOPER

The Experiment Station and the Agricultural Extension Service have conducted numerous experiments and field tests during the last several years. Results, regardless of method of application or fungicides used, have been inconsistent. However, the number of instances of increased stands and yields points to in-row fungicide application at planting as needed insurance especially on farms with a history of poor stands due to seedling diseases.

Following is a list of some fungicide mixtures which have given excellent to poor results varying from location to location and from season to season in North Carolina and in other cotton producing states: PCNB-Captan (various formulations and trade names); PCNB-Thiram 10-10 (various trade names); PCNB-Terrasole[®] (Terraclor Super X); PCNB-mercury (Panterra); 1-Chloro-2-nitropropane (Lanstan); 1, 4-dichloro-2, 5-dimethoxybenzene (Demosan). Use on trial basis according to manufacturers' directions. Check rows are suggested in each field for grower evaluation of benefits from fungicide treatment used.

Note: In-furrow spray, dust and granular applications have given better results than planter box treatments. Demosan has given better results when applied in the furrow than when incorporated on seed as slurry overcoat.

Caution: Follow label directions for safe use of nematocides and fungicides.

PEANUT DISEASES

Leafspot Control

J. C. WELLS and W. E. COOPER, Plant Pathology

Material	Active Ingredient	Method	Time & No. of applications	Rate of Application
Copper-Sulfur	4% metallic copper from either tribasic copper or cuprous oxide mixed with 325-mesh sulfur.	Dust	5 applications. 1st application last week in June or not later than July 10. Following applications at 14-day intervals.	1st—15 lb./a. 2nd—18 lb./a. 2nd—18 lb./a. 3rd—20 lb./a. 4th & 5th, if needed—20 lb./a.
Liquid copper copoloid, TC90	Copper salts of fatty & rosin acids 48%. Copper as metallic 4%.	Spray	Same as above	1/2 to 3/4 gal. liquid copper /a. per application in 12 to 25 gals. water; depending on the application equipment used (see footnote).*
Cal-Cop 10 For Cop 80 Cop 10	Copper ammonia complex	Spray		
Kocide 101	Cupric Hydroxide (Metallic Copper eq. 56%)	Spray	Same as above	2 lb. in 25 gal. of water/application
Polyram	[ethylenebis [dithiocarbamate]] zinc and [dithiois] [thiocarbonyl] [iminoethylene] bis [dithiocarbamate] zinc	Dust 5%	Same as above	20 lb./acre
Dithane M45 or Manzate 200	zinc ion and manganese ethylene bisdithio carbamate—80%	Spray	Same as above	1-1 1/2 lb./a.
Cyprex	dodine 65%	Spray	Same as above	3/4 to 1 lb./a. in 25 to 30 gals. water

* The amount of water may vary with sprayer equipment used. Three (D2-13) nozzles/row operating at 60 lbs. pressure and a tractor speed of 4 miles/hr. will deliver 12-13 gals. of spray per acre (36-inch row width). Three (D3-25 nozzles/row operating at 60 lbs. pressure and a tractor speed of 4 miles/hr. will deliver 28 gals./acre (36-inch row width).

Southern Stem Rot Control

Material	Formulation	Method*	Time of Application	Rate of Application
Terraclor	3.75% pentachloronitrobenzene (PCNB) in landplaster	Landplaster** spread to a 12" band centered over rows	Early pegging (late June to early July)	400 lb./a. Application
	20% PCNB dust	Dust soil in 12" band centered over the rows	Early pegging (late June to early July)	60 to 75 lb./a.
	75% PCNB—wetable powder	Spray soil in a 12" band centered over the rows	Early pegging (late June to early July)	15 to 20 lb./a.

* Following treatment do not throw untreated soil on treated land.

** Caution: Even distribution is of utmost importance.

Caution: Do not feed hay from treated peanuts to livestock.

Nematode Control

Nemagon 8.6 or 12.1 EC or 12.1 concentrate or Fumazone 70 Fumazone 86 (8.6 lb. to 9 lb. actual per acre). Apply at planting, chisel application 4 to 6 inches deep in center of row. Thimet, Zinophos combination

(Thimet 7½% + Zinophos 7½%) at 7 to 10 lb. per acre of 15% material has given good control of thrip and stilet nematodes (such as dagger, meadow, root knot, ring, spiral, sting and stubby root). Apply as 14-inch band treatment with granular applicator centered over the row followed by mixing with soil immediately ahead of planting. In areas of moderate to light infestation Di-Syston at the rate of two lb. active per acre when applied in a 12-inch band over the row directly in front of the planter at planting has given good results.

Pod Rot Complex and Nematode Control

Apply Vorlex 30 days prior to planting at a depth of 8 inches using 1 chisel per row and immediately follow with two disc throwing a bed 12 to 14 inches wide and 12 to 14 inches high. A 3 gal./acre rate is suggested.

KEEP PESTICIDES IN PROPERLY LABELED CONTAINERS

and

“Read The Label”

FIELD CROP SEED TREATMENT

H. R. GARRISS, J. C. WELLS, T. T. HEBERT, W. E. COOPER, Plant Pathology

Crop	Disease Controlled	Materials	Active Ingredient	Method	Dosage
Cotton	Damping-off, seed decay, angular leafspot, anthracnose.	Ceresan M	ethyl mercury p-toluene sulfonanilide 7.7%	dust	3 oz./100 lb. reginned seed
		Panogen 15	methyl mercury-dicyandiamid 2.2%	liquid	3 oz./100 lb. reginned seed
		Ceresan L	methyl mercury acetate and methyl mercury 2, 3 dihydroxy propyl mercaptide (Hg 2.25%)	liquid	3 oz./100 lb. reginned seed
Wheat	Seed decay, stinking smut, seed-borne seedling blight and root rot.	Ceresan M	ethyl mercury p-toluene sulfonanilide 7.7%	dust	1/2 oz./bu.
Ceresan L		methyl mercury acetate and methyl mercury 2, 3 dihydroxy propyl mercaptide (Hg 2.25%)	slurry or liquid	according to mfr. label	
Oats	Seed decay, seedling blight loose and covered smut.	Panogen 42	methyl mercury-dicyandiamid 6.3%	slurry	1/4 oz./bu.
Barley		Covered smut, black loose smut, seed-borne scab, seedling blight, stripe. (Note: Chemicals listed are recommended for wheat, oats, & barley)	Panogen 15	methyl mercury-dicyandiamid 2.2%	liquid
	Ortho L. M. Seed Protectant		methyl mercury 8-hydroxyquinolinolate 2.7% (Hg 1.5%)	slurry or liquid	1/4 oz./bu.
Barley + Wheat	Loose Smut	Vitavax*	2, 3 dihydro 5 carboxanilido 6 methyl 1, 4 oxathiin	dry, mist or slurry	3 oz./100 lb. seed
Corn	Seed decay, seedling blight seedling root rot.	Thiram 50, Arasan 50	thiram 50%	dust	1 1/2 oz./bu.
		Arasan 75	thiram 75%	dust	1 oz./bu.
		Phygon XL	dichlone 50%	dust or slurry	1 oz./100 lb. seed 1 lb./1 gal. water
		Orthocide 75 Captan 75	captan 75%	dust or slurry	3/4 oz./bu. according to mfr. label

Caution: Do not use treated seed for food or feed.

* Seed purpose only (Foundation & Registered Seed).

FIELD CROP SEED TREATMENT (continued)

Crop	Disease Controlled	Materials	Active Ingredient	Method	Dosage
Peanuts	Seed decay.	Arasan 75, Difolatan	thiram 75%	dust	2 oz./100 lb. of seed 5 oz./100 lb. of seed
		Captan + Botran	— 1:1 Combination	dust	5-6 oz./100 lb. seed
Soybeans	Seed decay, damping-off.	Thiram 50, Arasan 50 Arasan 75, Panoram 75 Arasan SFX Arasan SPM	thiram 50% thiram 75% thiram 75%	dust dust slurry or dust	2 oz./bu 1 1/3 oz./100 lb. according to mfr. label
		Orthocide 75	captan 75	dust slurry	1 1/2 oz./bu. according to mfr. label
Sorghum	Seed decay, seedling blight, loose and covered kernel smut	Arasan 75 Panoram 75 Arasan SPM Arasan SFX	thiram 75%	dust slurry	1 1/3 oz./bu. of seed according to mfr. label
		Ceresan M Ceresan L	ethyl mercury p-toluene sulfonanilide 7.7% methyl mercury acetate and methyl mercury 2, 3 dihydroxy propyl mercaptide (Hg 2.25%)	dust or slurry slurry or liquid	1/2 oz./bu. according to mfr. label according to mfr. label
		Panogen 42 Panogen 15	methyl mercury- dicyandiamid 6.3% methyl mercury- dicyandiamid 2.2%	slurry liquid	1/4 oz./bu. 1/2 oz./bu.
		Ortho L. M. Seed Protectant	methyl mercury 8-hydroxyguinolinolate 2.7% metallic mercury 1.5%	slurry or liquid	3/4 oz./bu.
		Orthocide 75 Arasan 75 Panoram 75	captan 75% thiram 75% thiram 75%	dust dust dust	8 oz./100 lb. of seed 5 1/3 oz./100 lb. of seed 5 1/3 oz./100 lb. of seed

Caution: Do Not Use Treated Seed For Food or Feed.

TOBACCO—BLUE MOLD AND ANTHRACNOSE CONTROL

FURNEY A. TODD, C. J. NUSBAUM and G. B. LUCAS, Plant Pathology

Material	Active Ingredient	Method	Time and number of Applications	Rate
Dithane Z-78 or Parzate	zineb	spray or dust	1st application when plants are about the size of a dime. Following applications twice per week until plants free of blue mold are assured for transplanting—(usually 8 to 12 applications).	For spray: zineb 3 lb./100 gal. water (2½ level tablespoonfuls/gal.). For dust treatment: Mixture containing 6.5% zineb with talc or pyrophyllite.
Fermate Nu-Leaf Ferradow	ferbam 76%	spray or dust	Same as above.	For spray: 76% ferbam 4 lb./100 gal. water (5 level tablespoonfuls/gal.). For dust treatment: mixture containing 11.4% ferbam with talc or pyrophyllite.
Dithane M-22 Manzate	maneb *	spray or dust	Same as above.	For spray: maneb ½ lb./100 gal. water (1 level teaspoonful to 1 gal. water. (For dust treatment: mixture containing 1.4% maneb with talc or pyrophyllite.
Polyram	[ethylenebis [dithio-** carbamato] zinc and [[dithiobis] (thiocar- bonyl) iminoethylene] bis [dithiocarbamate] zinc	spray or dust	Same as above.	For spray: Polyram 80% WP, 3 lb./100 gal. water. For dust treatment: Polyram 3½% dust.

* Maneb fungicides have the advantage of being cheaper but have the disadvantage of not being as safe. Therefore, growers using maneb fungicides should be sure to use only the recommended rates.

TOBACCO—WILDFIRE CONTROL IN BURLEY PLANT BEDS

FURNEY A. TODD and C. J. NUSBAUM

Material	Active Ingredient	Method	Time and Number of Applications	Rate
Antibiotics	streptomycin sulfate or streptomycin nitrate	spray	5 applications. Start when plants are in 2-leaf stage and put on 1 application a week for 5 weeks.	Use a 200 PPM* solution at rate of 5 gals./9 x 100 ft. bed. Follow mfr. suggestions in determining amount required to give 200 PPM dilution.
		drench	Same as above.	Use a 100 PPM solution at rate of 10 gal./9 x 100 ft. bed. Follow mfr. suggestions in determining amount required to give 100 PPM dilution.

* PPM is an abbreviation for "parts per million".

** No information has been obtained in N. C. on effectiveness of Polyram on control of anthracnose. Note: Streptomycin is more effective when applied as spray treatment.

FUMIGANT NEMATOCIDES FOR TOBACCO*

FURNEY A. TODD and C. J. NUSBAUM

Fumigant	Gals. Per Acre			Control of:		Minimum Waiting Period (days)
	Row	Broadcast	Root Knot	Lesion		
D-D, Vidden D & Others (dichloropropene-dichloropropane)	10	20	Good	Good	14	
Telone (dichloropropene)	8	16	Good	Good	14	
EDB-85 (ethylene dibromide)	2½	4½	Good	Poor	14	
Dorlone & others (dichloropropene plus ethylene dibromide)	6	12	Good	Good	14	
Fieldfume, & others (dichloropropene-dichloropropane plus ethylene dibromide)	6	12	Good	Good	14	
Penphene** (tetrachloriothophene)	¾	1½	Good	—	14	
Vorlex (methylisothiocyanate—20% chlorinated C ₃ hydrocarbons—80%)	6	—	Good	Good	21	

* This table presents the relative effectiveness of treatments against certain nematodes. Overall performance may vary according to the infestation level and seasonal conditions.

** Penphene sometimes causes early season stunting of plants. In most cases, the plants recover and crop performance is satisfactory.

NEW CONTACT NEMATOCIDES FOR TOBACCO*

Nematocide	Pounds Per Acre		Control of:		Waiting Period
	Row	Broadcast	Root Knot	Lesion	
Dasanit 10% G O, O-Diethyl O-P (Methylsulfinyl) phenyl phosphorothioate	60	80	Fair	—	None
Mocap 10% G S, S-dipropyl O-Ethyl phosphorodithioate	60	80	Fair	—	None

* Information on the performance of these materials is limited. Additional data on rates and method of application are needed before widescale use is recommended. Use on a trial basis only is suggested.

MULTIPURPOSE DISEASE CONTROL SOIL FUMIGANTS FOR TOBACCO

(Nematodes, Black Shank, and Black Root Rot)

FURNEY A. TODD and C. J. NUSBAUM

FUMIGANT	Gals. Per Acre	Minimum Waiting Period (days)
Vorlex (methylisothiocyanate—20%)	6	21
Chlorinated C ₃ Hydrocarbons—80%		

* Effective in reducing incidence of black shank and black root rot when used with resistant varieties.

SOIL FUMIGANTS FOR REDUCTION OF BLACK ROOT ROT IN BURLEY TOBACCO

FURNEY A. TODD and C. J. Nusbaum

FUMIGANT*	Gals. Per Acre (Row)	Minimum Waiting Period (days)
Telone (dichloropropene)	12	14
Vorlex (methylisothiocyanate—20%)	6	21
chlorinated C ₃ hydrocarbons—80%		

* Effective only when used with black root-rot resistant varieties.

DON'T STORE PESTICIDES IN PANTRIES AND CUPBOARDS

THINK! IS THIS THE PROPER DOSAGE?

READ! WHAT DOES THE LABEL SAY?

CONTROL OF MOSAIC OF TOBACCO, PEPPERS, AND TOMATOES WITH MILK

G. B. LUCAS, J. C. WELLS and F. A. TODD, *Plant Pathology*

Treating tobacco, tomato or pepper plants with milk at transplanting time will greatly reduce losses to tobacco mosaic.

Best control is obtained when the plants are sprayed and the hands are dipped in milk as follows:

(1) Spray the plant bed within 24 hours before pulling the plants with 5 gallons of whole or skim milk or 5 lb. of dried skim milk mixed with 5 gallons of water applied to 100 sq. yd. of plant bed.

(2) Dip the hands about every 20 minutes in whole or skim milk or a mixture of 1 lb. of dried skim milk to 1 gallon of water. The hands are dipped during plant pulling and transplanting to the field. Dipping the hands in milk whenever the plants are handled during the growing season also greatly reduces the spread of tobacco mosaic virus.

BOTRYTIS BLIGHT OF TOMATO

J. C. WELLS & N. N. WINSTEAD

Botrytis blight (gray mold) caused by a fungus has become one of the most serious diseases of tomato foliage, stems, blossoms and fruit in the mountain area of N. C. The disease is most severe during periods of cool, wet weather.

Infected leaves and stems show typical light tan or gray spots. The infected areas soon become covered by a heavy gray growth of fungus and numerous spores. Air currents easily detach these spores and spread them to healthy leaves, blossoms and fruit.

On the blossom and fruit, water soaking and softening of the tissues infected are first noted. Infected areas are usually irregular in shape, grayish or yellowish green in color, later becoming a dark gray as the fungus develops & destroys blossoms & fruits. The fungus frequently attacks fruits through the stem or through cracks or other wounds. Young green tomatoes sometime have small whitish rings on their surface. These markings, called ghost spot, are caused by the same fungus that causes gray mold.

Control: The season will greatly influence the timeliness of the application of fungicides. The fungicide Dyrene at 2 lb./100 gals. water has given the most effective control of Botrytis blight when added to the maneb spray schedule about the time the second bloom cluster opens and continued for 4 to 5 applications. Dyrene is compatible with maneb and the major tomato insecticides.

STRAWBERRY DISEASE CONTROL

C. N. CLAYTON and J. C. WELLS, Plant Pathology

Gray Mold Fruit Rot & Leaf Diseases

For gray mold or Botrytis fruit rot, leaf spot, leaf blotch and leaf scorch, use one of the following materials at 10-day intervals from the time new growth starts until harvest:

Sprays: Captan 50% WP—4 lb./100 gal. water or 4 tablespoons/gal. OR Thiram 65% WP*—2 lb./100 gal. water or 2 tablespoons/gal.

Dusts: Captan 7.5% OR Thiram 5% Dust* at 40 lb. per acre.

The Albritton and Earlibelle varieties are relatively resistant to leafspot and scorch. On varieties other than these, it is suggested that Tribasic Copper or Cyprex be used until bloom and captan or thiram from bloom until harvest.

Gray mold fruit rot, which affects all varieties, is more effectively controlled with captan or thiram than with Tribasic Copper or Cyprex. Use copper and Cyprex according to manufacturers' directions.

Note: Tribasic Copper, captan—No time limitation.

* Thiram—Remove residue by washing if application is made within 3 days of harvest.

Nematode Disease Control

1. Set only nematode-free plants
2. Soil fumigation according to suggestions listed in the following table:

Crop	Material	Concentration	Method	Schedule
Strawberry (Commercial berry production)	D-D or Telone	40 gal./a. 30 gal./a.	Broadcast treatment	Fall application is preferred 30 days or more prior to planting.
	Nemagon or Fumazone	1 gal./a. actual material 1st application; ½ gal. 2nd application	Row side-dress treatment	Treat immediately after harvest with 1 gal actual and 1 mo. later with ½ gal. actual.
	Methyl bromide, or Methyl bromide + Chloropicrin	Use according to manufacturer's directions. Use according to mfg. label		
	Vorlex	Use according to manufacturer's directions.		
(Commercial plant production)	DD or Telone	Double fumigate using above dosage of DD or Telone	Broadcast treatment	1st application 60 days prior to planting; 2nd application 1 week after the first application
	methyl bromide (98%) or Methyl bromide + Chloropicrin	Use according to manufacturer's directions. Use according to manufacturer's directions.		
	Vorlex	Use according to manufacturer's directions.		

ORNAMENTAL & FLORAL CROPS DISEASE CONTROL

ROBERT AYCOCK, R. D. MILHOLLAND, J. C. WELLS and H. R. GARRISS

Crop	Disease Controlled	Material	Active Ingredient	Method	Concentration	Schedule	
Azalea (See Ext. Cir. 246)	Ovulinia petal blight	Dithane Z-78 or Parzate	zineb 75%	spray	1 lb./100 gal.	3 times each week during bloom.	
		Thylate	zineb 6%	dust	6% dust		
	Exobasidium leaf and bud gall	Bordeaux		copper	spray	6-2-100	For extensive planting 1 to 2 applications 10 to 14 days apart, beginning when galls are first evident.
		(For average home garden: Control by hand picking and destruction of galls.)					
	Phytophthora root rot	Dexon	p-dimethyl-amino-benzenediazo sodium sulfonate 70%	soil drench	1 tsp./4 gals. water	Apply to 20 sq. ft. of area; follow with additional water to allow penetration to 3 to 5 inches. Repeat every 10-14 days.	
	Parasitic nematodes	Nemagon or Fumazone	DBCP	soil drench	2 tsp./sq. yd.	Once every 20-24 months	
Boxwood	Phytophthora root rot	Dexon	p-dimethyl-amino-benzenediazo sodium sulfonate 70%	soil drench	1 tsp./4 gals. water	Refer to azalea schedule	
	Parasitic nematodes	Nemagon or Fumazone	DBCP	soil drench	Light soils 2 tsp./sq. yd. Heavy Soils 3 tsp./sq. yd.	Refer to azalea schedule	

DON'T STORE PESTICIDES IN REACH OF CHILDREN

ORNAMENTAL & FLORAL CROPS DISEASE CONTROL (continued)

Crop	Disease Controlled	Material	Active Ingredient	Method	Concentration	Schedule
Camellia (See Ext. Clr. No. 246)	Sclerotinia flower blight	Terraclor 20% Dust	PCNB	dust	2½ lb./100 sq. ft. (20% dust)	Late December or early January.
		Terraclor 75%		drench	1 cup in enough water to give thorough coverage of 100 sq. ft.	Same as above
		sulfur	sulfur	dust evenly	1 lb./180 sq. ft.	Late December or early January.
	Glomerella die-back	Fermate, Nu-Leaf Ferradow	ferbam 76%	spray	1½ lb./100 gal. water	Just before & during the period of leaf fall.
	Phytophthora root rot	Dexon	p-dimethyl-amino-benzenediazo sodium sulfonate 70%	soil drench	1 tsp./4 gals. water	Apply to 20 sq. ft. of area; follow with additional water to allow penetration to 3 to 5 inches. Repeat every 10-14 days. Refer to azalea schedule.
Parasitic nematodes	Nemagon or Fumazone	DBCP	soil drench	2 tsp./sq. yd.	Refer to azalea schedule	
Carnation	Alternaria blight	Dithane Z-78 or Parzate	zineb 75%	spray	1½ lb./100 gal. water + spreader	7-day intervals.
		Captan 50W or Orthocide 50W	captan 50%			
		Dithane Z-78 or Parzate	zineb 75%	spray	2 lb./100 gal. water	

ORNAMENTAL & FLORAL CROPS DISEASE CONTROL (continued)

Crop	Disease Controlled	Material	Active Ingredient	Method	Concentration	Schedule
Chrysanthemum	Leaf rust	Fermate, Nu-Leaf or Ferradow	ferbam 76% (In early infections pick off)	spray	1½ lb./100 gal. + spreader (leaves and destroy)	When scattered rusts pustules are evident
	Mycosphaerella ray blight	Dithane Z-78 or Parzate	zineb	spray	1 lb./100 gal. plus spreader	2 to 3 times per week as flowers begin to open
	Septoria leaf spot*	Fermate, Nu-Leaf or Ferradow	ferbam 76%	spray	1½ lb./100 gal. plus spreader	7 to 10 day intervals Cover underside of foliage
	Pythium root rot	Dexon	p-dimethyl-amino-benzenediazo sodium sulfonate	drench	1 tsp./4 gals. water	Drench at 10- to 14- day intervals.
	Pythium Root parasitic nematodes	Methyl bromide	methyl bromide		1 to 2 lb./100 sq. ft.	At least 10 to 14 days prior to planting.
	Foilar nematodes	Wettable Parathion 15%	parathion 15%	spray	1½ to 3 lb./100 gal.	7- to 10-day intervals
Dogwood (See Ext. Folder No. 150)	Antraenose leaf and flower spot	Orthocide 50 or Captan. 50W	captan 50%	spray	2 lb./100 gal.	1st delayed dormant
	Septoria	Manzate or Dithane M-22	maneb 80%	spray	1½ lb./100 gal.	2nd petal fall
		Phaltan 50W	N-trichloro-methylthio-phthalimide 50%	spray	2 lb./100 gal.	3rd mid-summer 4th pre-dormant (after flower buds are well formed)
Gladiolus (See Ext. Cir. No. 448 and Plant Path. Inf. Note No. 108)	Botrytis foliage blight	Dithane Z-78 Parzate Ortho Zineb	zineb 75%	spray	1½ to 2 lb./100 gal. plus spreader	Every 7 to 10 days during normal weather, every 2 to 3 days during wet periods.
	Curvularia leaf spot	Dithane Z-78, Parzate or Dithane M-22, Manzate	zineb 75% maneb 80%	spray	1½ to 2 lb./100 gal. plus spreader	Same as for Botrytis.
	Corm rots-Pre storage (Fusarium, Botrytis, Curvularia)	Dowicide B	sodium trichlorophenate	steep	1½ to 2 lb./100 gal.	Treat for 20 to 30 min. within 3 days of harvest.
	Corm and cormel rots-pre-planting (Fusarium, Curvularia)	Ceresan L	methyl mercury dihydroxy propyl mercaptide & methyl mercury acetate (Hg 2.25%)	steep	2 to 3 pts. 100 gals.	Treat for 10 min. just prior to planting.
	Hot water treatment	of cormels is also recommended. Consult N. C. Agr. Exp. Sta. Tech. Bull. 168.				
	For sprouted corms	Captan 50W Orthocide 50W	captan 50%	steep	12 lb./100 gal.	Treat for 20 min. just before planting.
White-break	Rogue and destroy all plants when symptoms first appear.					

* Use ferbam in the early season and zineb after bud development.

ORNAMENTAL & FLORAL CROPS DISEASE CONTROL (continued)

Crop	Disease Controlled	Material	Active Ingredients	Method	Concentration	Schedule
Iris	Heterosporium Leaf spot	Dithane Z-78 or Parzate	zineb 75%	spray	2 lb./100 gal. + spreader	Every 10 to 14 days.
	Bulb and stem nematode	Formalin	formaldehyde	long steep	2 qt./100 gal. 110-111° F for 3 hr.	2 hr. pre-steep in water 75° F. 4- Vatsol O. S. at 8 oz./100 gal. Bulbs must be treated before root de- velopment begins; this is usually 3 to 4 weeks follow- ing early harvest
Dutch Iris	Bulb and stem rot caused by southern wilt organism	Terraclor	pentachloronitro- benzene 10%, 20%, 75%	row	24 lb./acre	Apply 6 lbs. actual in- gredient to soil in 1 ft. band on row at (1) plant- ing time, (2) about April 1, (3) April 15, and (4) May 1. Apply as drench or dry application
				Broad- cast 100 to 150 lb./acre		Apply prior to planting. Mix with top 2 or 3 in- ches of soil by discing or roto-tilling.
Narcissus	Bulb and stem nematode	Formalin	formaldehyde	long steep	2 qt./100 gal. 110 to 111° F for 4 hr.	2 hr. pre-steep in water 75° F Vatsol O. S. at 8 oz./100 gal Treat 3 wks. following harvest.
	Basal rot (Pre-storage)	Mersolite W or	phenyl mercury acetate, 96.5%	steep	1 lb./400 gal.	Treat for 5 to 15 min. within 3 days after har- vest.
		*Dowicide B	sodium trichloro- phenate, 85%	steep	3 lb./100 gal.	Treat for 15 min. within 3 days after harvest.
	Basal rot (Pre-planting)	Mersolite W or	phenyl mercury acetate, 96.5%	steep	1 lb./600 gal.	Treat 5 to 15 min. prior to planting.
		Dowicide B	sodium trichloro- phenate, 85%	steep	3 lb./100 gal.	Treat for 15 min. just prior to planting.
	Stagonospora leaf scorch	Bordeaux	copper sulfate + lime	spray	8-8-100 + spreader	Every 10 to 14 days after 4 to 6 inches of foliage growth.
Dormant bulbs	Formalin	formaldehyde	steep	2 qt./100 gal.	Treat for 2½ to 4 hrs. at temperature of 110 to 111.5° F.	

* Do not use Dowicide B on bulbs to be marketed in retail trade as slight staining and shrinkage often occurs. This treatment is effective against basal rot organism and also inactivates cysts of soybean cyst nematode.

ORNAMENTAL & FLORAL CROPS DISEASE CONTROL (continued)

Crop	Disease Controlled	Material	Active Ingredient	Method	Concentration	Schedule
Rose (See Ext. Cir. 200 revised)	Black spot	Phaltan	N-trichloro-methylthiophthalimide 75%	spray	1.0 lb./100 gal.	Apply every 7 days and twice each week during rainy periods.
		Daconil 2787	tetrachloroisophthalonitrile 75%		0.75 lb./100 gal.	
	Powdery mildew	Acti-dione PM	cycloheximide	spray	1 to 2 level tbs.	According to mfr. directions.
		Karathane cr Mildex	dinitro caprylphenylcrotonate 22%	spray		
Parasitic nematodes	Nemagon or Fumazone	DBCP	soil drench	1 tsp./sq. yd.	Refer to azalea schedule	
Combinations of fungicides and insecticides are available for use on Roses						
Snapdragon	Rust	Dithane Z-78 or Parzate	zineb 75%	spray	1½ lb./100	Every 10 to 14 days.
	Cercospora leafspot	Dithane Z-78 or Parzate	zineb 75%	spray	1½ lb./100 gals.	Every 10 to 14 days.
Tulip	Botrytis blight	Fermate, Nu-leaf or Ferradow	ferbam 76%	spray	1½ to 2 lb./100 gal.	Begin when foliage is 2 to 4 inches tall; spray at 7 to 10 day intervals; 4 successive applications should be adequate.
Zinnia	Alternaria leaf and flower spot	Bichloride of mercury	mercury	soak seed treatment	1 oz./7½ gal.	Treat 5 to 10 min. and rinse thoroughly.
	Mildew	(Same as for roses)				
Flowering annuals	Damping-off	Fermate, Nu-leaf, Ferradow	ferbam 76%	drench	½ lb./50 gal. water, ½ gal./sq. yd.; 2 lb./100 gal. water, ½ gal./sq. yd., respectively.	1st application immediately after seeding, following applications at 10-day intervals until plants are ready to set.
		Captan 50-W Orthocide 50W	captan 50%			
		Dowfume MC 2 Pestmaster Bed Fume Kolker Brom-O-Gas	methyl bromide	Fumigation	2 lb./100 sq. ft.	10 to 14 days before planting.

NEMATODE CONTROL IN WOODY ORNAMENTALS

J. C. WELLS

Several plant parasitic nematode species have been found associated with decline of woody ornamentals in the Coastal Plain and Piedmont areas of North Carolina. A few examples of plants which are severely affected are species of boxwood, holly, azalea, ligustrum; also, *Camellia japonica*, peony, roses (*) and a few miscellaneous shrubs. Damage to plants from these root-feeding nematodes is progressive and often results in poor growth, low vigor, yellowing or bronzing of the foliage, stem die-back, failure to respond to fertilizer and eventually death.

To avoid plant decline planting sites should be treated and non infested plants should be set. Where symptoms of decline are evident, treat established plants with a fumigant. Materials and methods are available for applying soil fumigants to meet the requirements of commercial use. However, for the individual home owner, the **drench method** is the easiest and least expensive to use. For established plants, prepare a small ridge of soil around the perimeter of area to be treated, then with spade fork or other tool poke holes in the soil to aerate the root zone—be sure to include entire area to be treated. Add the chemical to water and drench the area prepared for treatment. Apply when soil temperatures are 50° to 70° F. When injection treatments are used, the soil moisture should be sufficient for seed germination.

<u>Materials</u>	<u>Rate</u>	<u>Area Treated</u>
Nemagon 50% E.C.	2 teaspoonfuls per gallon water	9 sq. ft.
Fumazone 70E	2 teaspoonfuls per gallon water	9 sq. ft.
Fumazone 44E	2 teaspoonfuls per gallon water	9 sq. ft.

Additional water should be used around each plant that is treated to insure that the chemical has penetrated the complete root zone. Usually a 6-inch depth is adequate.

* For roses, the above dosage rate should be reduced by one-half.

Nematode Control In Lawns

Many kinds of nematodes attack lawn grasses. Unthrifty growth and dying sod in a properly managed lawn can often be traced to nematode damage. Fumigate with Nemagon, Fumazone or Sarolex 1½ pints per 1000 sq. ft. in enough water to carry the chemical to a 6-inch depth or Mocap 10% granular 5 to 7 lb. per 1000 sq. ft. Dasanit 2⅔ lb. of 10% granules per 1000 sq. ft. Mocap or Dasanit are suggested for commercial turf only.

DISEASES—LAWNS AND TURF

J. C. WELLS, Plant Pathology

Diseases of lawn grasses can be controlled. However complete control of any soil inhabiting disease pathogen which attacks grasses is difficult and rather expensive.

Quite often we bring in soil disease organisms, or make conditions ideal for their development, through cultural practices we use to establish lawns or promote their growth. Such practices as adding black soil, manure, compost or other organic matter to lawns often increase disease problems. Sprinkling or irrigating also favors the spread and development of all grass diseases.

Proper management of lawns, especially timing and frequency of mowing, can aid in checking most grass diseases. Frequent high clipping helps prevent thatching or matting of the foliage and permits better light penetration and air drainage. This will slow down disease development.

Chemical control can be effective if done properly. To be most effective, it should be started before disease development and continued at regular intervals throughout the season. The following commercial fungicides, used according to directions, have been helpful in reducing losses from such diseases as Brown Patch, Dollar spot, Rust, Leafspot, Cottony blight, Fairy ring and Slime mold.

Materials	Active Ingredients	Method	Rate Per 1000 sq. ft.	Schedule
Acti-dione + PCNB	cycloheximide + pentachloronitrobenzene	drench	4 oz.	Apply at 7 to 10-day intervals starting in June when conditions for disease development such as high humidity are prevalent. Continue treatment throughout August or until disease is checked.
SCOFE DYRENE	2, 4 dichloro-6-0-chloroanilino-s-triazine 50%	drench	4 oz.	
Ortho Lawn & Turf Fungicide	captan + pentachloronitrobenzene + cadmium	drench	6 oz.	
Daconil 2787	Tetrachloroisophthalonitrile 75%	drench	2-4 oz.	
Tersan OM	thiram 75% + mercury	drench	6 oz.	
Terraclor	pentachloronitrobenzene 75%	drench	4 oz.	
Fore	zinc ion and manganese ethylene bis-dithiocarbamate	drench	4 oz.	
Memmi 8C	mercury fungicide	drench	2 oz.	

SOIL TREATMENT FOR CONTROL OF NEMATODES AND CERTAIN SOIL-BORNE DISEASES *

Plant Pathology Department

Trade Name (List may not be complete)	Active Ingredient	Approximate Dosage			Relative Effectiveness Against:			
		Per Acre		Per 100 sq. yds. in Plant Bed	Nematodes		Bacterial and Fungus Diseases	Weed Seeds
		Row	Broadcast		Root Knot	Meadow		
D-D Oma-D Vidden D	dichloropropene- dichloropropane mixture	10 gal.	20 gal.	½ gal.	good	good	poor	poor
Telone	dichloropropene	8 gal.	16 gal.	½ gal.	good	good	poor	poor
Dowfume W-40 Soilfume 40	ethylene dibromide	9 gal.	18 gal.	½ gal.	good	poor	poor	poor
Dowfume W-85 Soilfume 85		2¼ gal.	4½ gal.	1 pt.	good	poor	poor	poor
Dorlone	dichloropropene plus ethylene dibromide				good			
Oma Fume D-EDB Field Fume	dichloropropene-dichloro- propane mixt. + ethy. dib	6 gal.	12 gal.	3 pt.	good	good	poor	poor
Larvacide Picfume	chloropicrin		28 gal.	¼ gal.	good	good	good	fair
Various trade names	methyl bromide 98% plus chloropicrin 2%			9 lb. tobacco 18 to 27 lb. tomato	exc.	exc.	good	exc.
Nemagon Fumazone	1-2 dibromo -3- chloropropane	Follow mfg. label			good	good	poor	poor
Vorlex	Methyl isothio- cyanate 20% Chlorinated hydrocarbons 80%	Follow mfg. label			good	good	good	good
MC88 or Brozone	Methyl bromide + Chloropicrin	Follow mfg. label			exc.	exc.	good	exc.

SWEET POTATO STORAGE HOUSE STERILIZATION

H. R. GARRISS, L. W. NIELSEN and CHARLES W. AVERRE, Plant Pathology

Materials	Active Ingredient	Dosage	Method and Requirements
Larvacide Picfume	chloropicrin	½ lb./1000 cu. ft. space.	(Fumigation)—*Follow mfr. label.
Sulfur	sulfur	1 lb./1000 cu. ft. space.	(Fumigation)—*(1) Distribute several metal containers throughout the house, placing them on bricks or similar material to avoid fire. Don't use containers with soldered bottoms. (2) Place the required amount of sulfur over crumpled paper in each container and set paper afire. (3) Close door tightly for 24 hrs. Air house thoroughly before storing potatoes. Disinfect cleaned crates by leaving them in the house during fumigation.
Semesan Bel S	mercury	1 lb./15 gal. water	(Spray or Drench)—(1) Remove crates from house. (2) Mix materials in the proportions recommended and spray all inside parts of house thoroughly. (3) Dry out house before storing potatoes.

NOTE: Rot producing germs will live for a long period of time on the walls and floor of the storage house and on crates. If these germs are not killed they may start rotting of the new crop. Either of the above treatments may be used with success after the house and surroundings have been thoroughly cleaned of all rotted potatoes, dirt and other trash.

* House must be "air" tight and moist with water 1 or 2 days in advance of fumigation for satisfactory results with fumigation treatments. Maintain temperatures of 70° F. or above during fumigation.

USE CHEMICALS SAFELY — FOLLOW LABEL DIRECTIONS

VEGETABLE CROP DISEASE CONTROL SCHEDULE

C. W. AVERRE, H. E. DUNCAN, J. C. WELLS, S. F. JENKINS, D. L. STRIDER and L. W. NIELSEN, Plant Pathology

Follow Manufacturer's label in all cases.

CROP	Disease Cont'd	Material	Active Ingredient	Method	Time, Number of Applications and Limitations	Rate of Application	
Bean (pole)	Rust	sulfur	sulfur	dust	Apply 4- to 7-day intervals beginning at first sign of rust or about July 1.	30 to 40 lbs./A.	
		Dithane M-22 Manzate D	maneb 80%	dust	Ditto Min. days to harv. 7	1.5 lb./100 gal.	
Cabbage	Downy mildew (in plant beds)	Dithane Z-78 Parzate Ortho Zineb	zineb 75%	spray	Every 3 to 4 days. Min. days to harv. 7	4 lb./100 gal. water	
		Manzate D Dithane M22 Special	maneb 80%	spray	Every 7 days Min. days to harv. 7	1½ lbs./100 gal. water	
		See Cucumbers					
Cantaloupe	Downy mildew Brown spot Gummy stem blight	See Cucumbers					
	Powdery mildew	Karathane	dinocap	spray	5-7 days interval Min. days to harv. 7	½ to 1 lbs./100 gal.	
Carrots	Alternaria blight	Dithane M22 Special Manzate D	maneb 80%	spray	7- to 10-day intervals & after heavy rains beginning at first sign of blight or about June 15.	1½ lbs./100 gal. water	
Cucumbers	Downy mildew and anthracnose	Manzate D Dithane M22 Special	maneb 80%	dust or spray	According to manufacturer's label.		
		Scab (Mt. area)	Manzate D Dithane M22 Special	maneb 80%	spray	At weekly intervals until bloom, then twice weekly through all harvest.	According to manufacturer's label.
		Phaltan Folpet	folpet 50%				
Eggplant	Damping-off (plant beds)	Semesan	hydroxymereurichlorophenol 30% (mercury equivalent 19.0%)	drench	According to manufacturer's label.		
		Captan 50-W Orthocide 50W	captan 50%	drench	10-day intervals	2 lbs./100 gal. Apply ¾ gal./sq. yd.	
Irish potatoes	Late and early blight	Spray when late blight appears and at weekly intervals thereafter for Piedmont and Coastal counties; or start when plants are 6 to 8 inches high in Mountain counties.					
		Difolatan	complex name	spray	see above	1½ lb./100 gal.	
		Dithane M22 Spec.	maneb 80%	spray	see above	1½ lb./100 gal.	
		Manzate D	maneb 80%	spray	see above	1½ lb./100 gal.	
		Polyram WP 80	complex carbamate	spray	see above	1½ lb./100 gal.	
		Tribasic Copper	metallic copper 53%	spray	see above	4 lb./100 gal.	

CROP	Disease Controlled	Material	Active Ingredient	Method	Time, Number of Applications and Limitations	Rate of Application	
Lima beans	Stem anthracnose	Dithane Z-78 Parzate	zineb 75%	spray	1st application when disease is first noticed or when plants have started to bloom. Repeat at 5- to 7-day intervals until harvest.	1½ lb./100 gal. water. Apply at rate of 100 gal./acre per application. (See Exp. Sta. Spec. Cir. No. 11).	
		Dithane M-22 Special Manzate D	maneb 80%				
Lettuce	Damping-off (plant beds)	Fermate, Nu-leaf Ferradow	ferbam 76%	drench	1st application immediately after seeding, following applications at 10-day intervals until plants are ready to set.	½ lb./50 gal. water, ½ gal./sq. yd., respectively.	
		Captan 50-W Orthocide 50W	captan 50%				
Pepper	Bacterial spot and other seed-borne diseases	Bichloride of mercury	mercuric chloride	soak	Soak seed in solution for 5 min., rinse thoroughly and dry. Seed treatment only.	One 8-grain tablet/qt. of water.	
	Seed decay, pre-emergence damping	Arasan or Thiram 50 dust	thiram 50%	dust	Treat all seed according to manufacturer's label. Seed treatment only.		
	Bacterial spot (in the plant bed only).	Agri-mycin or Phytomycin plus Tribasic Copper Sulfate	streptomycin plus fixed coppers	spray	7- to 10-day intervals; more often during wet seasons. Plant bed only.	4 lb. 50% fixed copper plus 200 ppm streptomycin/100 gal. water.	
		Agri-mycin 500	streptomycin plus fixed copper				
	Damping-off (Plant beds)	Orthocide 50W Captan 50-W	captan 50%	Drench	1st treatment immediately after seeding; following applications at 10-day intervals until plants are ready to set.	1 lb./50 gal. water; ½ gal./sq. yd. ½ lb./50 gal. water; ½ gal./sq. yd.	
		Fermate, Nu-leaf Ferradow	ferbam 76%	Drench			
	Anthracnose	Dithane M22 Special Manzate D	Dithane M22 Special Manzate D	maneb 80%	spray	Start when first fruits begin to turn red. 10-day intervals—more often during wet seasons.	2 lb./100 gal. water
			Dithane Z-78 Parzate	zineb 75%	spray		
	Bacterial spot (in the field)	Bordeaux mixture	4 lb. copper sulfate 4 lb. hydrated lime 50 gal. water		spray	7- to 10-day intervals; more often during wet seasons.	100 to 150 gal./acre.
			Kocide 101	56% metallic copper	spray	5-10 days	1½-2 lbs./100 gal.
Cercospora leafspot	Dithane Z-78 Parzate	Dithane Z-78 Parzate	zineb 75%	spray	7- to 10-day intervals. Start spray schedule when the first fresh market fruits are harvested.	2 lb./100 gal. water.	
		Orthocide 50-W Captan 50-W	captan 50%	spray		3 to 4 lb./100 gal. water.	
		Dithane M22 Special Manzate D	maneb 80%	spray		2 lb./100 gal. water.	

VEGETABLE CROP DISEASE CONTROL SCHEDULE (Continued)

CROP	Disease Controlled	Material	Active Ingredient	Method	Time, Number of Applications and Limitations	Rate of Application
Pepper (continued)	Downy mildew or blue mold	Ferimate, Nu-leaf, Ferradow	ferbam 76%	spray or dust	1st application when blue mold appears in the vicinity. Following applications twice per week until plants are free of blue mold and are assured for transplanting.	Spray: 76% ferbam 4 lb./100 gal. water or 5 level tablespoonfuls/gal. Dust: 1.4% ferbam.
		Dithane Z-78 Parzate	zineb 75%	Spray or dust		Spray: 75% zineb 3 lb./100 gal. water (2½ level tablespoonfuls/gal.). Dust: 6.5% zineb.
		Dithane M22 Special Manzate D	maneb 80%	Spray or dust		Spray: 80% maneb ½ lb./100 gal. water (1 level tablespoonful/gal.). Dust: 1.4% maneb.
	Southern blight	Terraclor	pentachloronitrobenzene	Transplant solution	At transplanting.	4 lb. 75% wettable Terraclor/100 gal. water; ½ pt./plant.
Squash	Scab (summer-Mt. area)	Manzate D Dithane M22 Special	maneb 80%	spray	At weekly intervals until bloom, then twice weekly through all harvest.	According to mfr. label.
		Phaltan Folpet	folpet 50%			
	Powdery Mildew	Sulfur WP	Sulfur	spray	5-7 day interval Don't spray on hot days	2-4 lb./100 gal.
Karathane		dinocap	spray	5-7 day interval Min. days to harv. 7	½-1 lb./100 gal.	
Tomato	Late blight Early blight Gray leafspot	Manzate D Dithane M22 Special	maneb 80%	spray	According to manufacturers label.	
		Dithane M45 Manzate 200	zinc ion and manganese ethylene bisdithiocarbamate 80%	spray		
	Botrytis blight	Dyrene	2, 4 dichloro-6-(O-chloro-anilino)-triazine	spray	When disease first appears.	2 lb./100 gal. water
	Southern blight	Terraclor	pentachloronitrobenzene	transplant solution	At transplanting.	4 lb. 75% wettable terraclor/100 gal. water; ½ pt. plant.

VEGETABLE SEED TREATMENT

H. R. GARRISS, J. C. WELLS, S. F. JENKINS, D. L. STRIDER, L. W. NIELSEN, and C. W. AVERRE, Plant Pathology

Always use top quality seed obtained from reliable sources. If seed has not been treated proceed as follows:

Crop	Disease Controlled	Materials	Active ingredient	Method	Dosage
Bean (lima & snap)	Seed decay, pre-emergence damping-off	Arasan Thiram 50 Dust	thiram 50%	dust	1/3 tsp./lb.
Beet Swiss chard	Seed decay, pre-emergence damping-off	Arasan Thiram 50 Dust	thiram 50%	dust	1 tsp./lb.
Broccoli Brussels sprouts Cabbage Cauliflower Collard Kale Kohlrabi Mustard Radish Turnip Tendergreen	Seed decay, pre-emergence damping-off	Buy hot water treated seed and treat with Semesan	hydroxymercurichlorophenol 30% (mercury equivalent 19.0%)	dust	½ tsp./lb.
Cantaloupe Cucumber Pumpkin Squash Watermelon	Seed decay, pre-emergence damping-off, anthracnose (cantaloupe, watermelon, cucumber), angular leaf spot (cucumber).	Bichloride of mercury	mercuric chloride containing 74% metallic mercury	soak	1 oz./7 gal. water (one 8-grain tablet/pt. water). Soak seed in solution for 5 min., rinse thoroughly and dry and treat with thiram, according to mfr. label.
Carrot	Seed decay, pre-emergence damping-off	Semesan	hydroxymercurichlorophenol 30% (mercury equivalent 19.0%)	dust	½ tsp./lb.
Eggplant	Seed decay, pre-emergence damping-off	Spergon	chloranil 98%	dust	1 tsp./lb.
Lettuce Romaine	Seed decay, pre-emergence damping-off	Spergon	chloranil 98%	dust	2/3 tsp./lb.
Parsley Parsnip	Seed decay, pre-emergence damping-off	Semesan	hydroxymercurichlorophenol 30% (mercury equivalent 19.0%)	dust	¼ tsp./lb.

Caution: Do not use treated seed for food or feed.

VEGETABLE SEED TREATMENT (continued)

CROP	Disease Controlled	Materials	Active ingredient	Method	Dosage
Pea (Garden)	Seed decay, pre-emergence damping-off	Spergon or	chloranil 98%	dust	1 tsp./lb.
		Semesan	hydroxymercurichlorophenol 30% (mercury equivalent 19.0%)	dust	¼ tsp./lb.
Pepper	Bacterial spot and other seed-borne diseases	Bichloride of Mercury	mercuric chloride containing 74% metallic mercury	soak	One 8-grain tablet/qt. of water. Soak seed in solution for 5 min., rinse thoroughly & dry.
	Seed decay, pre-emergence damping-off	Arasan or Thiram 50 Dust	thiram 50%	dust	Treat according to mfr. label after soaked seed are dry.
Irish Potato	Seedpiece decay	Captan 7% dust (various materials)	Captan	dust	¼-1 lb./cwt.
Sweet potato	General	Semesan Bel	12% hydroxymercurinitrophenol plus 2% hydroxymercurichlorophenol	dip	1 lb./7½ gal. water. Dip until wet in solution, dry (in shade) and bed without washing.
		Arasan 42-S	42% thiram	Soak	1 pt./5 gal.
		Vancide 51	Na-dimethyl dithiocarbamic acid, and Na-2-mercaptobenzothiozole	Soak	1 pt./6 gal.
Tomato	Seed decay, pre-emergence damping-off	Buy hot water treated seed and treat with Arasan	thiram 50%	dust	1 tsp./lb.

* tsp. means one level teaspoonful.

NOTE: For the simple dust treatments, such as Arasan, Semesan, Spergon, and zinc oxide, place the seed to be treated in a tight jar or other container, spread the required amount of dust over the seed, close the lid and shake or rotate until all the seed are thinly coated. (Never have the container more than ½ full of seed for any one operation.)

In treating small quantities of seed, such as a 10-cent paper packet, tear off one corner of the packet and place a "pinch" of the dust (about twice as much as can be picked up on the first ½ in. of the flattened end of a toothpick) in the package with the seed. Shake the seed and dust together for several minutes. All seed should be thinly coated.

Care should be used in handling these materials because some of them are poisonous.

For most crops, only one or two of the most commonly recommended materials are listed. However, in some cases, materials which are recommended only for certain crops may also be used on others, according to mfr. label.

Caution: Do not use treated seed for food or feed.

NEMATODE CONTROL IN VEGETABLE CROPS

CHARLES W. AVERRE and KENNETH R. BARKER, Plant Pathology

1. Rotate fields.
2. Set only nematode free transplants.
3. Follow manufacturer's label in all cases.
4. Fumigate according to guidelines listed in the following table:

Material	Broadcast rate ¹ (gal./acre)	Method	Schedule
DD Telone Vidden D	20	Broadcast or row	Fall application is preferred to spring application. Fumigate only when soil is moist. Avoid undecomposed trash in field. Wait 3 weeks before planting.
Vorlex ²	7-10	Broadcast	
	10-12	Row ³	
Nemagon Fumazone	1.0-1.25 actual	Broadcast or row	Preplant application.
		Row	Postplant application.

¹ In row application, amount of material actually applied on an acre will depend on row width and will be a fraction of the broadcast rate.

² Vorlex at rates of 35-50 gal./acre is also an effective soil fungicide and herbicide. See entry under Vorlex.

³ Chisel should be set 6-8" deep and a high, wide bed thrown up over it.

VORLEX

J. C. WELLS and CHARLES W. AVERRE

PLASTIC GREENHOUSE SOIL FUMIGATION

Vorlex, a new synergistic soil fumigant, possesses broad activity against fungi, nematodes, weeds and soil insects. It is especially suited for preplant (*Fusarium* and *Verticillium* wilts). Vorlex acts immediately upon application and is highly active even at soil temperature as low as 40°F.

Time of application

Treatment can be made either in spring or fall. Fall application is advisable for crops which are planted in the early spring.

Soil Preparation

Break up all clods and loosen soil thoroughly by cultivation one week before treatment. Deep tillage is recommended, particularly for deep rooted crops. Always work soil deeper than intended application depth. Soil moisture should be about right for seed germination; soil temperature should be 40° and above for best results.

Method of Application Broadcast—Dosage Rate 50 Gal. Per Acre

To obtain optimum performance, Vorlex should be injected into the soil by means of chisel- or blade-type applicator. Injection should be made 6 to 8 inches apart and at a soil depth of 4 to 8 inches, depending on the crop and the pest to be controlled. The soil should be firmed immediately after application using float, roller or cultipacker. If a tarp seal can be conveniently used, lower dosages may be

effective. A water seal is also effective. At 60°F. or above, leave soil undisturbed for 4 days after application. At the end of exposure period, soil should be aerated by cultivation or discing. Aeration should be continue until fumigant has completely escaped from the soil—usually 2 weeks to 30 days.

PLANT BED FUMIGATION

- (1) 7-10 days before treating, work up soil and keep moist.
- (2) Inject fumigant 4-5" deep on 8" centers at the rate of 35-40 gal/acre.
- (3) Roll or drag immediately after injection of fumigant.
- (4) Tarp for 4-7 days.
- (5) Disk lightly to break crust.
- (6) Wait 3 weeks before planting.

Precautions

DO NOT TAKE INTERNALLY. DO NOT GET IN EYES, ON SKIN OR CLOTHING. DO NOT BREATHE VAPORS. KEEP AWAY FROM HEAT OR FLAMES. USE ADEQUATE VENTILATION.

SELECTION, ADJUSTMENT, AND CARE OF SPRAYING AND DUSTING EQUIPMENT

JOHN W. GLOVER, Extension Agricultural Engineering

Three essentials of good spraying and dusting are:

1. Correct timing of application.
2. Proper chemicals and rates.
3. Proper equipment correctly used.

There is a type or size sprayer, duster, or fumigator available today for practically every application of insecticide, fungicide, or herbicide desired. Multiplicity of use is becoming an increasingly important factor in the selection of equipment. The following guiding principles regarding the selection and use of pesticide equipment should be considered:

1. Select equipment that will best fit the farming operation, considering acreage, crops, and labor that will use it.
2. On farms having small irregular shaped fields, a large duster or sprayer would be impractical, contributing to frequent breakage of equipment and poor application. Three to four row equipment is generally more desirable on the medium to small size farm.
3. When certain types of chemical weed control work are planned, separate spray equipment should be provided for this purpose only. See page 114 concerning cleaning 2,4-D, etc. from equipment.
4. Carefully adjust and calibrate equipment to apply recommended rates; otherwise, full benefits may not be obtained.
5. Dusting, spraying, and fumigation equipment is designed for specific types of application. While there is some degree of flexibility, a spray nozzle recommended for the application of an insecticide is not best suited for weed control work; or vice-versa.
6. Consideration should be given to selecting a sprayer or duster which is convenient to mount and dismount as well as to operate. Such features may mean a great deal to a busy farmer, in being able to make timely application.
7. High clearance, self-propelled dusters and sprayers cannot be justified on small farms; however, usually they are more satisfactory than any other type on large acreage and custom operations.
8. Use the proper pressure for spraying. Avoid high pressures above 30 psi for weed control work.

DUSTERS

Proper adjustment and operation are important in dusting as well as in spraying. The dust hopper, fan, fan cage, flexible air lines, and nozzles should be kept free of caked material. Nozzles should be placed directly over the row and only a few inches above the growing plant. One rather critical item on many tractor mounted dusters is the V-belt drive. To maintain proper air volume and velocity, the belt should be kept in good alignment and reasonably tight. A nozzle velocity of approximately 5,000 feet per minute is desirable, so that good flotation may be accomplished with sufficient drive to carry dust materials through the foliage of the plant and rebound, to some extent, from the ground. With more diligence in regard to care, adjustment, and operation, more effective dusting and better control may be accomplished with even less material than many farmers are now using.

At the present time dusters are not effective for weed control.

SPRAYERS

The majority of field sprayers in use today are of the hydraulic type in which the spray pressure is built up by direct action of the pump on the spray mixture.

PUMP SELECTION

A. PUMP TYPES AND CHARACTERISTICS

Pump Type	Available Construction Material	Available Port Sizes (Inches)	Maximum Pressure psi	Capacity at 500 RPM for a ¾ in. port size pump		Effect of Abrasive Materials	Repairable
				GPM @ 50 psi	GPM @ 100 psi		
Gear	Bronze	½-1	80	6		Severe	No
6 Nylon Roller* (Standard)	Cast Iron or Ni-resist	¾ and 1½	75	6	—	Moderate*	Yes
6 Nylon Roller* (Hi Port)	Cast Iron or Ni-resist	¾	100	8	6.5	Moderate*	Yes
7 Nylon Roller*	Cast Iron or Ni-Resist	¾	100	10	9	Moderate*	Yes
8 Nylon Roller*	Ni-resist or Bronze	¾	150	10	9	Moderate*	Yes
Diaphragm	Cast Iron or Ni-resist	¾	75	5	—	Practically none	Yes
Piston	Cast Iron	½-1	400			Moderately little	Yes

* Roller pumps are available with rubber rollers in lieu of nylon rollers. The rubber rollers have the longest life when used with abrasive materials, but the maximum pressure is reduced to 75 psi. A pump equipped with rubber rollers will cost an additional \$5.

B. CONSTRUCTION MATERIALS

Pumps are available in a variety of materials such as brass, aluminum, cast iron, and corrosion resistant alloys. Select a pump that will not be corroded by material to be sprayed. Leather, neoprene, etc. may be used for seals.

C. PUMP SIZE

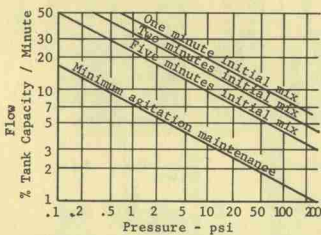
The size or capacity of a pump is measured in gallons per minute or gallons per hour. Select a pump with capacity at least double the total nozzle output. By selecting an oversize pump, normal wear will not reduce capacity to the extent it would require early overhaul or replacement, and the excess overflow can be used for agitation.

D. MOUNTING OF PUMPS

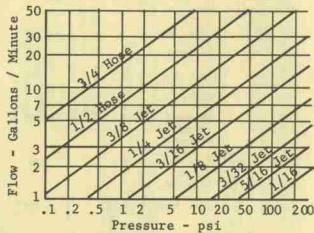
Most tractor mounted sprayer pumps are directly attached to the power take-off shaft of the tractor. Pumps so mounted should be allowed to float freely on the shaft with a short length of chain attached to prevent rotation of the pump. If such a pump is bolted down rigidly to the drawbar, undue strain will be placed on the pump bearings and seals causing failure within a few hours of operation.

AGITATION

For wettable powders use a jet agitator or a mechanical agitator. If a jet agitator is used, place it in the bottom of the spray tank and connect it to the end of an additional return pipe (not the regular return line from the pressure regulator) from a high pressure line on the pump side of the control manifold. This will permit full operation of the pressure regulator, and the jet agitator will operate at all times.



JET AGITATION REQUIREMENTS



FLOW RATES PER JET

NOZZLE SELECTION

The spray nozzle is a most important part of any sprayer. Since no single type nozzle is capable of all spray requirements, there is a wide variety of types and capacities available. Nozzles vary with respect to capacity (gallons per minute—G.P.M.) or (gallons per hour—G.P.H.), spray pattern angle (65° to 160°) and type of spray pattern as listed below.

A. NOZZLE SPRAY PATTERN TYPE

1. Flat (Fan) Spray Nozzle—used for broadcast or boom spraying such as weed control work. Drift is less than that with cone nozzles. Rate tapers at edge, must be overlapped approximately 50% for even distribution.
2. Even Flat Spray Pattern Nozzle—used for band spraying. Spray pattern is uniform throughout. Do not overlap.
3. Whirlchamber (non-clog)—wide angle hollow cone nozzles may be used in place of flat fan nozzles. Clogging is minimized because of design. Less drift occurs due to wide angle spray patterns (lower boom height) and large droplet size.
4. Flooding nozzles—may also be used for herbicides and fertilizer solutions. Flooding nozzles operate at equally low pressures as Whirljets with even wider spray patterns (up to 160°); however, pattern width varies with pressure.
5. Boomless (or Cluster) Nozzles—used for wide swath work 30 feet or more. May be single or cluster nozzles. Spray droplets sizes vary, and does not give as uniform coverage as other types. Spray pattern more affected by wind than boom type.
6. Hollow Cone Spray Pattern Nozzle—used for better coverage of crop foliage and where very uniform distribution is desired. Use for all row crop applications.
7. Solid Cone Spray Pattern Nozzle—used for hand spraying and spot spraying.
8. Off Center Spray Pattern Nozzle—Available in both flat and cone spray pattern types. Used on end of boom to increase effective boom swath, and other uses.

B. NOZZLES MATERIAL

1. Brass—most commonly used, relatively inexpensive.
2. Stainless Steel—non-corrosive, relatively expensive.

3. Aluminum and Monel—resistant to moderately corrosive materials.
4. Hardened Tungsten Carbide Tips—used for highly abrasive materials.
5. Plastic—used for non-abrasive materials, corrosion resistant inexpensive.

C. STRAINERS

Most nozzles are equipped with either mesh or slotted strainers having slightly smaller openings than the nozzle orifice which help to prevent clogging. A suction strainer should be used to protect the pump and a line strainer to reduce nozzle and nozzle strainer clogging.

CARE AND STORAGE

Cleaning and storage of pesticide equipment is another very important step in a good control program. Dusters, either hand operated or power driven, should be carefully cleaned and lubricated before storage.

To store a sprayer or fumigator, it should first be thoroughly flushed either with water or kerosene, depending on the nature of material that has been used in the equipment. Disassemble as necessary so it can be easily handled. Nozzles should be removed, screens and tips cleaned and stored in a quart can of lightweight motor oil. After the pump has been cleaned and lubricated, rotate the pump by hand and suck into the pumps a small quantity of lightweight motor oil. If these simple things are done prior to storage the equipment will be in good condition next season. Uncoated steel tanks may be protected from corrosion by floating on a coating of light weight oil.

CLEANING

For cleaning sprayer equipment see section on sprayer contamination under "caution for using Herbicides" in Weed Control section.

THE MOST EFFECTIVE PESTICIDE MAY BE USELESS
WITHOUT PROPER APPLICATION

THINK! IS THIS THE PROPER DOSAGE?
READ! WHAT DOES THE LABEL SAY?

CALIBRATING A FIELD SPRAYER

JOHN W. GLOVER, Extension Agricultural Engineering

A. THINGS TO DO BEFORE CALIBRATING A SPRAYER

1. Rinse and fill supply tank with clean water.
2. Remove and clean all nozzles and screens. An old toothbrush or a match is handy to clean nozzles without damaging the nozzle orifice or screens. Do not use pocket knives or wire for cleaning.
3. Start sprayer and flush hoses and boom with plenty of clean water. (Remove end caps on boom).
4. Replace the screens and nozzles, and make sure all nozzles are spraying properly. Make sure all nozzles are of the correct spray pattern type and capacity. See Calibrating Tables.
5. Check all connections for leaks.
6. Adjust the pressure regulator to the selected pressure with tractor engine running at field-operating speed, and the nozzles operating.
7. If everything is working properly, you are now ready to calibrate the sprayer.

B. PRECAUTIONS

1. Calibrate the sprayer in the field under conditions similar to which it will be used. Speed of tractor will vary some for a hard road, an established pasture, or a plowed field. Level ground liquid outputs will vary from rolling land outputs. Spray on the contour where possible.
2. In sprayers delivering low volumes of solutions, it is absolutely necessary to use clean water to minimize nozzle plugging and excessive pump wear.
3. Some nozzles may vary in output enough to affect results. Check the output of each nozzle and replace any that have an output difference over 15 to 20%.
4. When using water to calibrate, the spray rate of the water may differ some from that of spray material mixture. Make the final check in the field while spraying with the spray material mixture.

C. METHODS

There are two methods outlined here for calibrating the sprayer. One method is to spray an acre and actually measure the amount of water or spray material used. This is the most accurate method and should always be used as the final check.

The other method involves attaching a quart jar under one nozzle and driving the sprayer in the field at a selected speed and pressure until a

quart of water or spray material is collected, then measure the distance traveled in the field to collect this quart. Check the application rate using the table entitled **sprayer calibration by the quart jar method**.

SPRAYER CALIBRATION BY SPRAY AN ACRE METHOD

A. PURPOSE

To determine the volume of liquid sprayed per acre under specific soil conditions, it is necessary that the volume of liquid applied per acre be known so that the proper amount of chemical can be included in that specified volume.

B. PROCEDURE

1. Make sure that the sprayer is properly mounted and that all parts are operating as they should. Nozzles of the right spray pattern type should be used.
2. Set pressure on the sprayer (not over 30 pounds for 2,4-D on crops) at the desired tractor speed (usually 3 to 6 m.p.h.). Do not depend on tractor governor maintaining speed. Use speedometer if necessary.
3. Determine the effective boom width in feet. Effective boom width for broadcast spraying is usually the length of the boom plus one and one-half feet; for row crops, the number of rows times the row width.
4. Calculate the distance the sprayer must travel to cover one acre by dividing effective boom width into square feet per acre.

$$\frac{43,560 \text{ (sq. ft. per acre)}}{\text{effective boom width}} = \text{the sprayer to travel to cover one acre.}$$

Measure this distance *in the field* to be treated.

5. Fill the sprayer tank with clean water to a measured depth (filling completely may lead to a loss of water on rough ground by splashing). Operate the sprayer over the measured acre at the speed and the pressure already selected. Sprayer should be started promptly at the starting point and stopped promptly at the end of the measured area.
6. Refill the tank to original level *measuring the water necessary to refill*. This is the amount of water necessary to spray one acre at the speed and pressure and with the nozzles used.
7. Repeat the process carefully as a check.
8. A change in pressure, speed, or nozzles will change the amount of liquid delivered per acre.

SPRAYER CALIBRATION AND NOZZLE SELECTION CHARTS

JOHN W. GLOVER, Extension Agricultural Engineering

SPRAYER CALIBRATION BY THE QUART JAR METHOD

Nozzle Spacing (Inches)	Distance Required to Catch One Quart per Nozzle at Various Rates of Application							
	5 gal./acre	7½ gal./acre	10 gal./acre	12½ gal./A.	15 gal./acre*	20 gal./acre	25 gal./acre	35 gal./acre
6	4356	2904	2178	1742	1452	1089	871	623
8	3265	2180	1633	1305	1089	816	652	466
10	2610	1744	1305	1045	871	652	522	373
12	2178	1452	1089	871	726	544	435	311
14	1868	1245	934	747	624	466	374	267
16	1633	1089	816	652	544	407	326	233
18	1452	968	726	580	484	363	290	207
20*	1306	871	653	522	435*	327	261	187
21	1245	830	622	498	415	311	249	178
22	1188	792	594	475	396	297	238	170
24	1089	726	545	436	363	272	218	156
30	871	581	436	348	290	218	174	124
36	726	484	363	290	242	182	145	104
42	622	415	311	249	207	156	124	89
48	545	363	272	218	182	136	109	78

CAUTION: Check output of all nozzles, and select an average nozzle to calibrate by.

Note: When nozzle spacing is not uniform or when more than one nozzle is used per row, use the average spacing. If three nozzles are used per row and the row spacing is 42 inches, the nozzle spacing would be $42 \div 3$, or 14 inches.

Example Using a boom sprayer with nozzles spaced 20 inches apart on the boom, if a quart of spray material (or water) is collected from one nozzle while the sprayer is traveling a distance of 435 ft., the rate of application is 15 gallons per acre. The speed is accounted for in the distance.

NOZZLE CAPACITIES IN GALLONS PER HOUR REQUIRED FOR VARIOUS RATES OF APPLICATION

Nozzle Spacing (Inches)	Rate of Application Desired											
	7½ Gallons per Acre			10 Gallons per Acre			12½ Gallons per Acre			35 Gallons per Acre		
	3 MPH	4 MPH	5 MPH	3 MPH	4 MPH	5 MPH	3 MPH	4 MPH	5 MPH	3 MPH	4 MPH	5 MPH
6	1.4	1.8	2.3	1.8	2.9	3.0	2.3	3.0	3.8	6.3	8.5	10.6
8	1.8	2.4	3.0	2.4	3.2	4.0	3.0	4.0	5.0	8.5	10.3	14.2
10	2.3	3.0	3.8	3.0	4.0	5.0	3.8	5.0	6.3	10.6	14.1	17.6
12	2.7	3.6	4.5	3.6	4.8	6.0	4.5	6.0	7.6	12.7	16.9	21.2
14	3.2	4.2	5.3	4.2	5.7	7.0	5.3	7.0	8.8	14.8	19.8	24.7
16	3.6	4.8	6.0	4.8	6.5	8.1	6.0	8.1	10.1	16.9	22.6	28.3
18	4.1	5.4	6.8	5.4	7.3	9.1	6.8	9.1	11.3	19.0	25.4	31.7
20*	4.5	6.0	7.5	6.0	8.1°	10.0	7.5	10.0	12.6	21.2	28.2	35.3
21	4.8	6.3	7.9	6.3	8.5	10.6	7.9	10.6	13.2	22.2	29.8	37.0
22	5.0	6.6	8.3	6.6	8.9	11.1	8.3	11.1	13.9	23.3	31.1	38.8
24	5.4	7.2	9.0	7.2	9.7	12.1	9.0	12.1	15.1	25.4	33.9	42.4
30	6.8	9.1	11.3	9.1	12.1	15.1	11.3	15.1	18.8	31.7	42.3	52.8
36	8.1	10.9	13.6	10.8	14.5	18.1	13.6	18.1	22.6	38.0	50.7	63.5
40	8.8	11.8	14.7	11.7	15.7	19.6	14.7	19.6	24.5	41.1	55.0	68.8
42	9.5	12.7	15.8	12.7	16.9	21.2	15.8	21.2	26.4	44.3	59.3	74.1
44	10.0	13.2	16.6	13.2	17.8	22.2	16.6	22.2	27.8	46.6	62.2	77.6
48	10.9	14.5	18.1	14.5	19.3	24.2	18.1	24.2	30.1	50.7	67.8	84.6

MPH = Miles per Hour

See Note above

* Example: If a spray application rate of 10 gallons per acre is desired, at 4 miles per hour, and the sprayer has a boom with nozzles 20 inches apart: From the table above, a nozzle with a capacity of 8.1 gallons per hour at the desired pressure would be required.

HOLLOW CONE SPRAY PATTERN NOZZLES

Capacity Gallons per Hour	FOR NON-ABRASIVE SPRAY MATERIALS				FOR ABRASIVE MATERIALS		
	Teejet Nozzle Tip No.		Delavan Nozzle Tip No.		Teejet and/or Delavan Nozzle Tip No. (Use with slotted strainers only)		
	40 psi	80 psi	40 psi	80 psi	80 psi	200 psi	400 psi
					Disc-Core	Dis-Core	Dis-Core
1	X1		CS 2	CS 1.5			
2	X2		CS 3.5	CS 2.5			
3	X3	X2	CS 5	CS 3.5			
4	X4	X3	CS 6.5	CS 5			
5				CS 6	D1-13		
6	X6	X4	CS 10	CS 6.5	D2-13		
8	X8	X6	CS 15	CS 10	D2-23	D1-13	
10	X10				D3-23	D2-13	D1-13
12	X12	X8	CS 20	CS 15		D2-23	D2-13
14	X14	X10	CS 25		D2-25	D3-23	
16					D3-25		D2-23
18	X18	X14	CS 30	CS 20			
20			CS 33	CS 25	D3-45		D3-23
22				CS 26		D3-25	
26	X26	X18		CS 33	D4-25		D2-25
35		X26			D4-45	D4-25	D3-25
40					D5-45		D3-45
50					D6-45	D4-45	D4-25

psi = pounds pressure per square inch.

HOLLOW CONE "WHIRL CHAMBER TYPE" SPRAY PATTERN NOZZLES

Capacity Gallons Per Hour	Delavan Nozzle No.*			Monarch Nozzle No. **		
	Type WR = 70°		Type WR-W = 120°	10 psi	20 psi	40 psi
	10 psi	20 psi	40 psi	Orifice - Lead	Orifice - Lead	Orifice - Lead
2				69 x 69		
3				61 x 61	69 x 69	
4				61 x 53	61 x 61	69 x 69
6	WR-W-2			53 x 53	61 x 53	61 x 61
8		WR-W-2		49 x 49	53 x 53	61 x 53
10						
12	WR-W-4		WR-W-2		49 x 49	53 x 53
14				3/32 x 3/32		
16		WR-W-4				49 x 49
18	WR-W-6			1/8 x 3/32		
20				1/8 x 7/64	3/32 x 3/32	
22				1/8 x 1/8		
25		WR-W-6	WR-W-4		1/8 x 3/32	3/32 x 3/32
30	WR-W-10			11/64 x 1/8	1/8 x 7/64	
35			WR-W-6			1/8 x 3/32
40		WR-W-10				1/8 x 7/64
45	WR-W-15			3/16 x 5/32	11/64 x 1/8	1/8 x 1/8
50	WR-W-20	WR-W-15	WR-W-10	7/32 x 3/16	3/16 x 5/32	11/64 x 1/8
75	WR-W-25			13/64 x 13/64		
85		WR-W-20	WR-W-15		7/32 x 3/16	3/16 x 5/32
100		WR-W-25			13/64 x 13/64	

*When ordering specify—type (WR 70° or WR-W 120°)—Size No.—Material (Brass or Stainless)—Pipe thread size (1/8 or 1/4) (male or female).

**When ordering specify—Body fig. no. (629 male or 631 female)—pipe thread size (1/8 or 1/4)—orifice and lead No.—spray angle (80° or 120°)—Material (brass or stainless).

FLAT SPRAY PATTERN NOZZLES FOR BROADCAST SPRAYING

(Rate or gallons per acre are for 35 psi and 4 MPH with nozzles spaced 20 inches apart)

Gallons per Acre	Spraying Systems "TeeJet"			Delavan			Monarch	Century
	80°	73°	65°	80°	73°	65°	70°	80°
5	800067	730077	650067	FS 2	FS 2.5	FS 2	F96-22	FA-5 FX-5
7.5	8001	730116	6501	FS 3	FS 3.5	FS 3	F96-25	
10	80015	730154	65015	FS 4	FS 4.5	FS 4	F96-32	FA-10 FX-10
12.5	8002		6502				F96-35	
15		730231		FS 5	FS 5.5	FS 5	F96-39	
20	8003	730308	6503	FS 6	FS 6.5	FS 6	F96-46	FA-20 FX-20
25	8004	730385	6504	FS 7	FS 7.5	FS 7		
30	8004	730462	6504	FS 8	FS 8.5	FS 8	F96-59	
40	8006	730616	6506	FS 9	FS 9.5	FS 9	F96-67	FA-40 FX-40
50	8008	730770	6508	FS 10	FS 10.5	FS 10	F96-99	

Note: Nozzles should be operated at a height that will allow 50% overlap between nozzles.

For a 20-inch nozzle spacing the proper heights above the plants or objects to be sprayed are:

80° spray angle, nozzles 19 inches high

73° spray angle, nozzles 22 inches high

65° spray angle, nozzles 23 inches high

EVEN FLAT SPRAY PATTERN NOZZLES FOR BAND SPRAYING

(Gallons per acre are for 40-inch rows, 40 psi, and 3 MPH.)

Gallons per Acre	80° Spraying Systems "TeeJet"	80° Delavan	80° Century
5	8001E	ES 3-80°	
7	80015E	ES 4-80°	
10	8002E	ES 5-80°	
13		ES 6-80°	FA 3E
15	8003E	ES 7-80°	
20	8004E	ES 8-80°	
25	8005E	ES 9-80°	
30	8006E		

Note: Nozzle height will control band width for 80° even spray nozzles as follows:

6 inches high = 10-inch band

7 inches high = 12-inch band

8 inches high = 14-inch band

TABLE OF WEIGHTS, MEASURES, AND DILUTIONS

A. Weights

- 28.35 gram = 1 ounce
- 16 ounces = 1 pound = 453.6 grams
- 1 gallon water = 8.34 pounds
- 1 cubic foot water = 62.4 pounds
- 1 gallon No. 2 fuel oil = 7 pounds
- 1 gallon kerosene = 6.7 pounds

B. Volume and Liquid Measure

- 3 teaspoons = 1 tablespoon = 14.8 cc
- 2 tablespoons = 1 fluid ounce = 29.6 cc
- 8 fluid ounces = 16 tablespoons = 1 cup = 236.6 cc
- 2 cups = 32 tablespoons = 1 pint = 473.1 cc
- 2 pints = 64 tablespoons = 1 quart = 946.2 cc
- 4 quarts = 256 tablespoons = 1 gallon = 3785 cc
- 128 fluid ounces = 1 gallon = 3785 cc

C. Land Measure

- 16½ feet = 5½ yards = 1 rod
- 66 feet = 4 rods = 1 chain
- 272¼ square feet = 30¼ square yards = 1 square rod
- 4356 square feet = 16 square rods = 1 square chain
- 43560 square feet = 160 square rods = 1 acre
- 43560 square feet = 10 square chains = 1 acre

LENGTH OF ROW REQUIRED FOR ONE ACRE

<i>Row Spacing</i>	<i>Length or Distance</i>
24 inch	7260 yards = 21,780 feet
30 inch	5808 yards = 12,424 feet
36 inch	4840 yards = 14,520 feet
42 inch	4149 yards = 12,447 feet
48 inch	3630 yards = 10,890 feet

TRAVEL SPEED CHART

Miles per Hour	Time Required in Seconds to Travel		
	100 Ft.	200 Ft.	300 Ft.
1	68	136	205
2	34	68	102
3	23	46	68
4	17	34	51
5	14	27	41
6	11	23	34
7	10	20	29
8	9	17	26
9	8	15	23
10	7	14	21

1 MPH = 88 feet per minute

1 MPH = 1.466 feet per second

Speed in MPH = No. 35-in. steps per minute

D. Tables of Dilutions for Liquids and Dusts

1. EQUIVALENT QUANTITIES OF LIQUID MATERIALS WHEN MIXED BY PARTS.

<i>Water</i>	<i>1-400</i>	<i>1-800*</i>	<i>1-1600</i>
100 gals.	1 qt.	1 pt.	1 cup
50 gals.	1 pt.	1 cup	1/2 cup
5 gals.*	3 tbsp.	5 tsp.*	2 1/2 tsp.
1 gal.	2 tsp.	1 tsp.	1/2 tsp.

* Example: If a recommendation calls for 1 part of the chemical to 800 parts of water, it would take 5 teaspoonfuls in 5 gallons of water to give 5 gallons of a mixture of 1-800.

2. EQUIVALENT QUANTITIES OF DRY MATERIALS (WETTABLE POWDERS) FOR VARIOUS QUANTITIES OF WATER:

<i>Water</i>	<i>Quantity of Material</i>					
100 gals.*	1 lb.	2 lb.	3 lb.	4 lb.*	5 lb.	6 lb.
50 gals.	8 oz.	1 lb.	1 1/2 lb.	2 lb.	2 1/2 lb.	3 lb.
5 gals.*	3 tbs.	1 1/2 oz.	2 1/2 oz.	3 1/4 oz.*	4 oz.	5 oz.
1 gal.	2 tsp.	3 tsp.	1 1/2 tbsp.	2 tbsp.	3 tbsp.	3 tbsp.

* Example: If a recommendation calls for a mixture of 4 lbs. of a wettable powder to 100 gallons of water, it would take 3 1/4 oz. (approximately 6 1/2 tsp.) to 5 gallons of water to give 5 gallons of spray mixture of the same strength.

Note: Wettable pesticide materials vary considerably in density. Therefore the teaspoonful (tsp.) and tablespoonful (tbsp.) measurements in this table are not exact dosages by weight but are within the bounds of safety and efficiency for mixing small amounts of spray.

3. EQUIVALENT QUANTITIES OF LIQUID MATERIALS (EMULSION, CONCENTRATES, ETC.) FOR VARIOUS QUANTITIES OF WATER:

<i>Water</i>	<i>Quantity of Material</i>					
100 gals.*	1/2 pint	1 pint	2 pints	3 pints	4 pints*	5 pints
50 gals.	4 fl. oz.	8 fl. oz.	1 pint	24 fl. oz.	1 quart	2 1/2 pints
5 gals.	1 tbs.	1 fl. oz.	2 fl. oz.	2 1/2 fl. oz.	3 fl. oz.	4 fl. oz.
1 gal.*	1/2 tsp.	1 tsp.	2 tsp.	3 tsp.	4 tsp.*	5 tsp.

* Example: If 4 pints of a liquid concentrate is recommended to 100 gallons of water, 4 teaspoonfuls of the chemical to 1 gallon of water will give a mixture of the same strength.

4. TABLE OF POUNDS OF ACTIVE INGREDIENTS PER GALLON, POUNDS PER PINT OF LIQUID, AND THE NUMBER OF PINTS FOR VARIOUS PER ACRE RATES

Pounds of active ingredients in one gallon of commercial product	Pounds of active ingredients per pint*	Pints of commercial product needed for each acre to give the following pounds of active ingredient					
		1/4 lb.	1/2 lb.	3/4 lb.	1 lb.	1 1/2 lbs.	2 lbs.
2.00	0.25	1	2	3	4	6	8
2.64	0.33	3/4	1 1/2	2 1/4	3	4 1/2	6
3.00	0.375	2/3	1 1/3	2	2 2/3	4	5 1/3
3.34	0.42	3/5	1-1/5	1-4/5	2-2/5	3-3/5	4-4/5
4.00	0.50	1/2	1	1 1/2	2	3	4
6.00	0.75	1/3	2/3	1	1 1/3	2	2 2/3

* 1 pint = 16 liquid ozs. Liquid ozs. may be measured with a discarded prescription bottle, liquid measuring cup, or a baby bottle.

5. TABLE OF AVAILABLE COMMERCIAL MATERIALS IN POUNDS ACTIVE INGREDIENTS PER GALLON NECESSARY TO MAKE VARIOUS PERCENTAGE CONCENTRATION SOLUTIONS*

Pounds of active ingredients in one gallon of commercial product	Pounds of active ingredients per pint*	Liquid ounces of commercial product per one gallon of solution* to make:				
		1/2 % liq. ozs.	1 % liq. ozs.	2 % liq. ozs.	5 % liq. ozs.	10 % liq. ozs.
2.00	0.25	2.68	5.36	10.72	26.80	53.60
2.64	0.33	2.02	4.05	8.10	20.25	40.50
3.00	0.375	1.78	3.56	7.12	17.80	35.60
3.34	0.42	1.59	3.18	6.36	15.90	31.80
4.00	0.50	1.34	2.68	5.36	13.40	26.80
6.00	0.75	0.89	1.78	3.56	8.90	17.80

* Based on 8.4 pounds per gallon (Weight of Water).

IMPORTANT NOTICE TO USERS OF PESTICIDE MANUAL

All pesticides and usages mentioned in this Manual conform to those currently registered with the Pesticides Regulation Division, USDA. However, effective December 31, 1967, registration under the Federal Insecticide, Fungicide, and Rodenticide Act for pesticide products now registered for use in a manner involving food or feed on a "no residue" or "zero tolerance" basis will be cancelled unless: (1) finite tolerances or exemptions from the requirement of tolerances have been established by the Food and Drug Administration, or (2) progress reports have been submitted to the Pesticides Regulation Division showing that studies are being conducted to obtain data to support finite tolerances.

If cancellations do occur, personnel at North Carolina State University will attempt to notify users of the Pesticide-Fertilizer Manual. However, everyone using, recommending, or selling pesticides should keep himself abreast of registration changes.

IN CASE OF POISONING

There are 7 Poison Control Centers in North Carolina, as shown below:

NORTH CAROLINA

Asheville	Poison Control Center Memorial Mission Hosp. 509 Biltmore Ave.	252-5331 Ext. 261	
Charlotte	Poison Control Center Mercy Hosp. 2000 E. 5th St.	334-6831	Gilbert Colina, Director
Durham*	Poison Control Center Duke University Hosp. Box 3024	684-8111	Jay Arena, M.D. Shirley K. Osterhout, M.D.
Hendersonville	Margaret R. Pardee Memorial Hosp. Fleming St.	693-6522	Fletcher L. Raiford, M.D. Margaret Gretz, Pharm.
Jacksonville	Poison Control Center Onslow Memorial Hosp. College St.	347-1241	S. C. Cox, M.D. Eleanor Williams, M.D.
Mount Airy	Poison Control Center Northern Hosp. of Surry County 830 Rockford St.	786-4151 Ext. 211	
Wilmington	Poison Control Center New Hanover Memorial Hosp. 2431 So. 17th St.	763-9021	C. M. Hicks, M.D. M. E. Underwood

* 24 hour service and available for consultant work