Chemicals

for control of

Plant Diseases

in North Carolina

HOWARD R. GARRISS AND J. C. WELLS

PLANT PATHOLOGY EXTENSION

NORTH CAROLINA STATE COLLEGE

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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:

Cooper 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, DC BP, D-D, ethylene dibromide, urea. Some of these are effective against fungus and nematode disease while others are mainly effective against nematodes.

Antibiotics—Streptomycin nitrate, streptomycin sulfate, terramycin, 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, Ferradow, Nu-Leaf, Karbam, Carbamate
ziram	Zerlate, Methasan, Zincate, Opalate White
nabam	Dithane D-14 (liquid), Parzate (liquid) Thiodow
zineb	Dithane Z-78, Parzate, Ortho Zineb
thiram	Arasan, Panoram, Tersan, Thiram 50 Dust, Thiram Naugets, Thylate
chloranil	Spergon, Spergon SL
captan	Orthocide, Captan 50-W
glyodin	Crag Fruit Fungicide 341
dichlone	Phygon, Phygon XL
maneb	Manzate, Manzate 75, Dithane M-22
dodine	Cyprex
folpet	Phaltan

The following example may serve to simplify the usage of common names for active fungicidal chemicals in active ingredient statements used in labeling. Let us consider two of the trade name products recommended for tobacco blue mold control, Dithane Z-78 and Parzate.

1. *Dithane Z-78 and Parzate* contain 65% zinc ethlylene bisdithiocarbamate or 65% zineb (common name)

The concentrate material containing 65% zineb is used in preparing spray mixtures for spray treatments.

Recommendations for dust treatments with these materials call for use of a dust mixture containing 6.5% zineb (10% Dithane Z-78, Parzate, etc.) Therefore, the label on packages of dust mixtures for tobacco blue mold control should show the active ingredient to be 6.5% zineb.

A 10% Dithane Z-78 or Parzate dust contains 6.5% zineb.

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 a mixture of these materials (Dorlone, Field Fume, Terra Fume-2) 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 contcat 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

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

Each year over 3000 diseased specimens are received for identification and recommendations. Unfortunately, many of these arrive in such poor condition that positive diagnosis is impossible. Specimens arriving unnamed, with no information, wilted, dry, crushed or in advance stages of decay represents time wasted for you and the Plant Disease Clinic. When sending specimens for examination *please read and follow instruction for collecting, packaging* and mailing specimens if accurate, prompt service is expected.

Collecting:

1. Get all parts of plants, including roots where practicable—above-ground symptoms may be caused by a root trouble. Dig out (don't pull up) plants and include soil. Roots of fleshy fruits and vegetables need special attention. Select fresh specimens showing young symptoms; do not send fleshy fruits and vegetables in advance stages of decay. When sending in cankers on shrubs and trees select canker or twig specimen from recent infections. Send in entire cankered portion with some of the healthy wood beyond the canker. Branches and twigs that have been dead for several months are useless for disease identification.
2. Collect several specimens showing various stages of the trouble and especially specimens showing early stages of disease. Collect also a healthy specimen if feasible. Be sure to include enough material for examination.
3. Wrap specimens immediately in wet paper, cloth or sacks and keep plants cool until shipped.

Packing and Mailing:

1. Wrap plants in moistened paper and cover with waxed paper, foil or other moisture proof material—don't overcrowd or crush plants. Fleshy vegetable and fruit specimens should be wrapped separately in waxed paper—do not pack in wet toweling as adding moisture to diseased fruits and vegetables hastens decay in transit.
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 during week days (Mon.-Fri.) rather than over week-end.

Information with the Specimen:

Describe the condition that you observed in the affected area and state whether or not you are concerned with some condition on the leaves, stems or roots. Give as much information about the conditions under which it was grown as possible, such as **acreage involved, per cent plants affected, per cent loss, occurrence (whether occasional, scattered small areas, large areas, whole field) as well as rotation, history of field, fertilizer, whether or not soil fumigation or weed killers were used, seed treatment, date of planting, whether dust or sprays were used.**

Note: Specimens that fail to meet the required recommendations given for collecting, packaging and information needed may have to be discarded upon arrival. Please help us make the Plant Disease Clinic more effective by giving complete information.

STOP! *Read the Label!*

PESTICIDES ARE NECESSARY—SO IS PROPER USE

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 are 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 College, Raleigh.*

Tobacco

Tobacco Blue Mold and Anthracnose Control—Ext. Cir. No. 397
Experiments on Tobacco Blue Mold Control—Exp. Sta. Tech. Bul. No. 111
Chemical Treatment for the Control of Weeds and Diseases in Tobacco—Exp. Sta. Tech. Bul. No. 119
Treatment of Tobacco Plant Bed Soils with Methyl Bromide—Exp. Sta. Bul. No. 399
Mosaic Control in Tobacco—Ext. Folder No. 128
Wildfire control in Burley Tobacco—Ext. Cir. No. 401
Soil Fumigation for Nematode Control in Tobacco—Ext. Cir. No. 402
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
Tobacco Disease Control Practices—Plant Pathology Inf. Note No. 56
Tobacco Disease Control Practices for Burley—Plant Pathology Inf. Note No. 61
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 and Nematodes in Tobacco Plant Beds—Ext. Cir. No. 427

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

Cotton

Cotton Diseases and Methods of Control—U.S.D.A. FB No. 1745
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

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 Leaf Disease of Oats—Plant Pathology Inf. Note No. 60
The Yellow Dwarf Disease of Small Grains—Plant Pathology Inf. Note No. 59

Soybeans

Soybean Diseases and Their Control—Plant Pathology Inf. No. 74
Producing Soybeans in North Carolina—Ext. Cir. No. 381-61

Vegetable Crops

Cabbage Production Guide—Ext. Folder No. 89
Cucurbit Diseases in North Carolina and Their Control—Exp. Sta. Bul. 380
Tomato Wilt Diseases—Ext. Folder No. 92
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
Control of Scurf & Black Rot—Exp. Sta. Bul. 406
Vegetable Plant Production—Ext. Cir. No. 231
Blister, A New Disease of Sweet Potato—Plant Pathology Inf. Note No. 93
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
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
Mosaic 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

Forage Crops

Forge Crop Diseases—Ext. Cir. No. 361
The Soybean Cyst Nematode Disease—Ext. Folder No. 126
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-Ext. Cir. No. 406. Leaflet No. 86
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. 29
Black Knot of Plum and Cherry—Plant Pathology Inf. Note No. 20
Commercial Strawberry Production—Ext. Cir. No. 422
Peach Spray Information—Ext. Cir. (In Press)
Cherry Leafspot and Sprays for its Control—Plant Pathology Inf. Note No. 21
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. 75
Home Fruit Sprays For Insect & Disease Control—Plant Pathology Inf. Note No. 91

Ornamentals

Azaleas and Camellias—Ext. Cir. No. 246
Azaleas and Camellias—Ext. Folder No. 185
Successful Rose Culture—Ext. Cir. No. 200 (revised)
Azalea and Camellia Leaf Gall—Plant Pathology Inf. Note No. 35
Camellia Flower Blight—Plant Pathology Inf. Note No. 36
Spot Anthracnose of Flowering Dogwood—Ext. Folder No. 150
Lawn Disease Control—Ext. Folder No. 135
Oak Wilt in North Carolina—Ext. Folder No. 98
Hemlock Twig Rust in North Carolina—Ext. Folder No. 172
Disease and Insect Control of Lawns—Plant Pathology Inf. Note No. 51
Nematode Control in Woody Ornamentals—Plant Pathology Inf. Note No. 63
Dutch Elm Disease—Plant Pathology Information Note No. 95

Miscellaneous

Wood Decay in Buildings—Plant Pathology Inf. Note No. 55
Nemagon & Fumazone Soil Fumigant Conversion Table—Plant Pathology Inf. Note No. 88
Nematode Assay Service Not Yet Available—Plant Pathology Inf. Note No. 92

PESTICIDES ARE A NECESSITY—USE THEM PROPERLY

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		At planting
		Row	Broadcast	(row only)
Nemagon Fumazone	1, 2-dibromo-3-chloropropane	½ gal. active	1½ gal. active	½ gal. active
D-D Oma-D Vidden-D, etc.	dichloropropane-dichloropene mixture	10 gal. product	20 gal. product	no
Telone	dichloropropene	8 gal. product	16 gal. product	no
Dowfume W-40 Soilfume 40	ethylene dibromide	9 gal. product	18 gal. product	no
Dowfume W-85 Soilfume 85		2¼ gal. product	4½ gal. product	no
Dorlone	dichloropene plus ethylene dibromide	6 gal. product	12 gal. product	no
Oma Fume D-EDB	dichloropropene-dichloropropane mixture plus ethylene dibromide			

IN-ROW FUNGICIDES FOR SEEDLING DISEASE CONTROL IN COTTON

H. R. GARRISS & W. E. COOPER

No one fungicide nor combination of fungicides has resulted in increased stands and yields at all locations and under all conditions. However, the number of instances of increased stands and yields is in favor of in-row treatment as an insurance factor where seedling diseases have been a major problem. The following materials and methods are suggested on a trial basis:

Material	Method (during planting)	Dosage
Terraclor 75% WP plus Orthocide 50-W OR Captan 50-W	Spray	2 lb. each to 10 or 20 gal. water/A.
Terraclor 10% plus Captan 10% (10-10 mixtures under various trade names)	Dust	12 to 15 lb./A.
Terraclor 10% plus Thiram 10% (10-10 mixtures under various trade names)	Dust	12 to 15 lb./A.

Note: Planter box application with 10-10 mixtures is not a satisfactory substitute for spraying or dusting where soreshin disease is a major problem. Do not use with acid delinted seed.

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

PEANUT DISEASES

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

Leafspot Control

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	3 to 5 applications. 1st application last week in June or not later than July 10. Following applications at 14-day intervals.	1st—15 lbs./A. 2nd—18 lbs./A. 3rd—20 lbs./A. 4th & 5th, if needed—20 lbs./A.
Sulfur	325-mesh dusting sulfur	Dust	Same as above	Same as above
TC-90	Liquid copper	Spray		½ to ¾ gal. TC-90/A. per application in 12 to 25 gals. water, depending on the application equipment used (see footnote).**
Manzate or Dithane M-22	maneb 80%***	Spray	4 to 6 applications. 1st application last week in June or not later than July 10. Following applications at 10-day intervals.	1st—1 lb./A. 2nd—1¼ lbs./A. 3rd—1½ lbs./A. 4th—1½ lbs./A. 5th—1½ lbs./A. 6th—1½ lbs./A.

* Additional applications are suggested if there is excessive rain during the season and especially if the peanuts are to be harvested by windrow.

** 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 (D2-25 nozzles/row operating at 60 lbs. pressure and a tractor speed of 4 miles/hr. will deliver 28 gals./acre (36-inch row width).

*** It is essential to increase the wetting capacity of this spray by adding 3 ounces of spreader-sticker per acre to the spray mixture.

Caution: Peanut hay treated with maneb should not be fed to livestock.

Southern Stem Rot Control

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

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./acre
	10% PCNB—dust 20% " " 40% " "	Dust soil in 12" band centered over the rows	Early pegging (late June to early July)	120 to 150 lb./ acre 60 to 75 lb./ acre 30 to 40 lb./ acre
	75% PCNB—wettable powder	Spray soil in a 12" band centered over the rows	Early pegging (late June to early July)	15 to 20 lb./Acre
Soil Treater	PCNB and Captan—dust	Dust soil in 12" band centered over rows	Early pegging (late June to early July)	60 to 75 lbs./Acre

* 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

1-2 dibromo-3-chloropropane sold under such trade names as Nemagon and Fumazone has given good control of **all types of nematodes** affecting peanuts when used as a preplant treatment 2 weeks before planting or at planting time. This material is also effective as a sidedress treatment 1 to 2 months after planting. Suggested rates for use are ½ to 1½ gals. active material/acre. **Caution:** Do not feed hay from treated peanuts to livestock.

A new chemical sold under the trade name Zinophos has given good control of the **sting nematode** affecting peanuts. Apply 10 to 20 lbs. Zinophos 10-G at planting time as a 12-inch band treatment with granular applicator placed in front of planter and centered over row. Apply up to 30 lbs. Zinophos 10-G/acre when infestation is severe.

Note: The above suggested dosages are based on standard row width & should be increased for bed row planting.

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
		2% Ceresan	ethyl mercury chloride 2%	dust	6 oz./100 lb. reginned seed
		Dow 9B	zinc tri-chlorophenate 50%	dust	4 oz./100 lb. reginned seed
		Panogen 15	methyl mercury-dicyandiamid 2.2%	liquid	3 oz./100 lb. reginned seed
		Ceresan 100	ethyl mercury acetate and ethyl mercury 2, 3 dihydroxy propyl mercaptide (Hg 2.3%)	liquid	3 oz./100 lb. reginned seed
		Orthocide 75	captan 75%	dust or slurry	2 oz./100 lb. reginned seed
		Chipcote 25	methyl mercury nitrile 5.41%	liquid	1½ oz./100 lb. reginned or acid delinted seed
		Chipcote 75	methyl mercury nitrile 1.85%	liquid	3 oz./100 lb. reginned or acid delinted seed
Wheat	Seed decay, stinking smut, seed-borne seedling blight and root rot.	Ceresan M	ethyl mercury p-toluene sulfonanilide 7.7%	dust	½ oz./bu.
		Ceresan M-2X	ethyl mercury p-toluene sulfonanilide 15.4%	slurry	according to mfr. label
Oats	Seed decay, seedling blight loose and covered smut.	Ceresan 75	ethyl mercury acetate and ethyl mercury 2, 3 dihydroxy propyl mercaptide (Hg 2.1%)	liquid	according to mfr. label
Barley	Covered smut, black loose smut, seed-borne scab, seedling blight, stripe.	Ceresan 100	ethyl mercury acetate and ethyl mercury 2, 3 dihydroxy propyl mercaptide (Hg 2.3%)	slurry or liquid	according to mfr. label
	(Note: Chemicals listed are recommended for wheat, oats, & barley)	Ceresan 200	ethyl mercury acetate and ethyl mercury 2, 3 dihydroxy propyl mercaptide (Hg 4.6%)	slurry	according to mfr. label
		Panogen 42	methyl mercury-dicyandiamid 6.3%	slurry	¾ oz./bu. after dilution
		Panogen 15	methyl mercury-dicyandiamid 2.2%	liquid	¾ oz./bu. after dilution
		Ortho L. M. Seed Protectant	methyl mercury 8-hydroxyquinolinolate 2.7% (Hg 1.5%)	slurry or liquid	¾ oz./bu.
		Chipcott 25	methyl mercury nitrile 5.41%	liquid	¼ oz./bu.
		Chipcote 75	methyl mercury nitrile 1.85%	liquid	¾ oz./bu.

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

FIELD CROP SEED TREATMENT (continued)

Crop	Disease Controlled	Materials	Active Ingredient	Method	Dosage
Corn	Seed decay, seedling blight seedling root rot.	Thiram 50, Arasan 50 Arasan 75	thiram 50% thiram 75%	dust dust	1½ oz./bu. 1 oz./bu.
		Arasan SFX Arasan SFM Thiram Naugets Panoram 75	thiram 75%	slurry	according to mfr. label
		Phygon XL	dichlone	dust slurry	1 oz./100 lb. seed 1 lb./1 gal. water
		Orthocide 75 Captan 75	captan 75	dust slurry	¾ oz./bu. according to mfr. label
Peanuts	Seed decay.	Thiram 50, Arasan 50 Arasan 75, Panoram 75	thiram 50% thiram 75%	dust	3 oz./100 lb. of seed 2 oz./100 lb. of seed
Soybeans	Seed decay, damping-off.	Thiram 50, Arasan 50 Arasan 75, Panoram 75 Arasan SFX Arasan SFM	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	1½ oz./bu. according to mfr. label
Sorghum	Seed decay, seedling blight, loose and covered kernel smut	Arasan 75 Panoram 75 Arasan SFM Arasan SFX	thiram 75%	dust slurry slurry	1 1/3 oz./bu. of seed according to mfr. label
		Ceresan M	ethyl mercury p-toluene sulfonanilide 7.7%	dust or slurry	½ oz./bu. according to mfr. label
		Ceresan 100	ethyl mercury acetate and ethyl mercury 2, 3 dihydroxy propyl mercaptide (Hg 2.3%)	slurry or liquid	according to mfr. label
		Ceresan 200	ethyl mercury acetate and ethyl mercury 2, 3, dihydroxy propyl mercaptide (Hg 4.6%)	slurry	according to mfr. label
		Panogen 42	methyl mercury-dicyandiamid 6.3%	slurry	according to mfr. label
		Panogen 15	methyl mercury-dicyandiamid 2.2%	liquid	¾ oz./bu.
		Ortho L. M. Seed Protectant	methyl mercury 8-hydroxyguinolinolate 2.7% metallic mercury 1.5%	slurry or liquid	¾ oz./bu.
Grasses	Seed decay, damping-off.	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

F. 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.

* 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

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.
Bordeaux mixture or	copper sulfate plus hydrated lime	drench	2 to 3 applications. 1st treatment when plants are through the ground; 2nd application 10 days later. If beds are hand weeded make another application immediately after weeding.	3 lb. of copper sulfate, 4 lb. of hydrated lime, 50 gal. water. (25 gal. mixture will cover 100 running ft. of bed 9 ft. wide or 150 running ft. of bed 6 ft. wide).
Microgel Tribasic copper C.O.C.S.	Basic copper sulfate containing approximately 50% metallic copper	same as above	Same as above.	1½ lbs./50 gal. water (25 gal. mixture will cover 100 running ft. of bed 6 ft. wide).

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

Note: Streptomycin treatments are more effective than copper treatments; the spray treatment is more effective than the drench.

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 lbs. of dried skim milk mixed with 5 gallons of water applied to 100 sq. yds. 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. In general, captan or Thylate (2 lbs. per 100 gals. water) added to the maneb spray schedule about the time the second bloom cluster opens and continued for 4 to 5 applications has given good control. In greenhouses, the use of fungicides and rigid control of humidity to keep the humidity low has reduced losses. *The fungicide Dyrene at 2 lbs./ 100 gals. water has given the most effective control of Botrytis blight;* however, it has caused irritation on the arms and neck of some growers. This could be eliminated with proper precautions such as using gloves and other protective clothing while spraying. Dyrene is compatible with maneb and the major tomato insecticides.

APPLE SPRAY PROGRAM

C. N. CLAYTON—G. F. TURNIPSEED

Name and Time of Spray Application	Amounts of Fungicides and Insecticides for 100 Gallons of Spray
LATE DORMANT Before visible growth starts	Use: Oil 2 gal. plus dinitro paste 1 qt. OR oil 2 gal. plus dinitro powder 1 lb. Very important spray for aphid eggs, mite eggs and scales. If this spray is omitted, mite and aphid control must be started in the PINK SPRAY.
DELAYED DORMANT When buds show ¼ to ½ inch new growth	Use: Lime-sulfur 2 gal. OR dodine 65% 12 oz. OR sulfur 3 lb. + ferbam 76% 8 oz. + dichlone 50% 4 oz. OR sulfur 3 lb. + ferbam 76% 8 oz. + dodine 65% 8 oz. Dodine (Cyprex) is very effective against scab; ferbam against rusts; sulfur against mildew.
PRE-PINK When center buds first show pink	Use: Same materials as in DELAYED-DORMANT SPRAY
PINK Just before bloom	Fungicide: Dodine 65% 12 oz. OR sulfur 3 lb. + ferbam 76% 8 oz. + dichlone 50% 4 oz. OR sulfur 3 lb. + ferbam 76% 8 oz. +dodine 65% 8 oz. Insecticide: Parathion 15% 1½ lb. OR Malathion 25% 4 lb. OR Guthion 25% 1½ lb. OR Sevin 50% 2 lb. OR Delnav 25% 1 pt. or 2 lb. Use either fungicide with either insecticide. Don't use parathion or Guthion unless all precautions are followed. Sevin doesn't control mites.
BLOOM About 1 week after PINK SPRAY if bloom period will extend to 12 to 14 days	Fungicide: Dodine 65% 8 oz. + ferbam 76% 8 oz. Don't spray in peak of bloom. Insecticide: Use NO insecticide during bloom. For fire blight control: Streptomycin at 60 to 100 ppm (parts per million) in sprays at 5-day intervals from the start to the end of bloom will help.
PETAL-FALL When most of petals have dropped	Fungicide: Dodine 65% 12 oz. OR captan 50% 2 lb. OR folpet 50% 2 lb. OR captan 50% 2 lb. + ferbam 76% 8 oz. OR sulfur 3 lb. + ferbam 76% 8 oz. + dichlone 50% 4 oz OR sulfur 3 lb. + ferbam 76% 8 oz. + dodine 65% 8 oz. Insecticide: Lead arsenate 3 lb. Dodine is only for scab; ferbam for rusts and leaf spot; sulfur for mildew and scab; captan or folpet for scab and black rot. Dodine russets Golden Delicious apples at times.
FIRST COVER 10 days after PETAL-FALL	Fungicide: Same as in PETAL-FALL Insecticide: Parathion 15% 1½ lb. OR Malathion 25% 4 lb. OR Guthion 25% 1½ lb. OR Sevin 50% 2 lb. OR Delnav 25% 1pt. or 2 lb.
SECOND COVER 2 weeks later	Fungicide: Captan 50% 2 lb. OR folpet 50% 2 lb. Insecticide: Parathion 15% 1½ lb. OR Malathion 25% 4 lb. OR Guthion 25% 1½ lb. OR Sevin 50% 2 lb. OR lead arsenate 3 lb. OR Delnav 25% 1 pt. or 2 lb. Sevin or lead arsenate doesn't control mites.
THIRD COVER 2 weeks later	Fungicide: Same as in SECOND COVER Insecticide: Same as in SECOND COVER To prevent mite build-up in July and August include in this spray one of the following miticides unless Guthion or Delnav is being used in all sprays: Kelthane emulsion concentrate 17% 1 qt. OR demeton (Systox) 25% 1 qt. OR Tedion 25% 1 lb.
FOURTH COVER 2 weeks later	Fungicide: Same as in SECOND COVER Insecticide: Same as in FIRST COVER
FIFTH COVER 2 weeks later	Fungicide: Same as in SECOND COVER OR substitute captan 50% 1 lb. + zineb 65% 1 lb. for captan 50% 2 lb. Insecticide: Same as in SECOND COVER
SIXTH COVER 2 weeks later	Fungicide: Same as in FIFTH COVER Insecticide: Same as in FOURTH COVER Don't use lead arsenate within 30 days of harvest. This applies to apples of all varieties.
SEVENTH COVER 2 weeks later	Fungicide: Same as in FIFTH COVER Insecticide: Parathion 15% 1½ lb. OR Malathion 25% 4 lb. OR Guthion 25% 1½ lb. OR Sevin 50% 2 lb.

EVEN THOUGH ADDITIONAL SPRAYS WILL BE REQUIRED, RED DELICIOUS OR GOLDEN DELICIOUS TREES SHOULD BE SPRAYED UNTIL MONTH OF HARVEST AND ROME OR STAYMAN TREES UNTIL 6 WEEKS OF HARVEST.

APPLE SPRAY PROGRAM (continued)

Note: In order to avoid excessive residue on fruit at harvest, pesticides should not be applied closer to harvest than indicated below:

Captan	1 day
Guthion	14 days
Lead arsenate	30 days
Malathion	3 days
Parathion	14 days
Sevin	1 day
Zineb	0 days
Tedion	1 day
Delnav	14 days
Demeton (Systox)	45 days
Kelthane	7 days

MATERIALS EFFECTIVE FOR APPLE DISEASE AND INSECT CONTROL

C. N. CLAYTON and G. F. TURNIPSEED

For detailed information on control of apple diseases and insects consult N. C. Agr. Ext. Circ. No. 406. The effectiveness of various fungicides and insecticides for control of major diseases and insects are listed.

Disease Controlled	Fungicide
Scab	Dodine Lime-sulfur dodine + ferbam + Sulfur Sulfur + ferbam + dichlone Captan Folpet
Mildew	Lime-sulfur Sulfur
Rust	Ferbam Zineb Thiram
Leaf Spot	Captan Ferbam
Fruit Spot	Folpet Ferbam Captan
Bitter rot	Folpet Captan Ferbam
Black rot	Folpet Captan Captan + zineb Thiram
Botryosphaeria rot	Folpet Captan Captan + zineb Thiram
Sooty blotch and fly speck	Folpet Captan + zineb Captan Thiram

Insects controlled	Material
Mites, aphid eggs, scales	Oil + dinitro
All Insects	Guthion Malathion Parathion Delnav
All insects except mites	Sevin
All insects except mites, aphids, apple seed chaleid	Lead arsenate
Mites (1 application)	Demeton 25% EC[a] 1 qt./100 gal. Kelthane 18.5% EC 1 qt./100 gal. Tedion 25% WP[a] 1 lb./100 gal. Delnav 25% 1 pt.

DON'T STORE PESTICIDES IN REACH OF CHILDREN

[a] EC = Emulsifiable. WP = wettable powder.

BLUEBERRY SPRAY PROGRAM

C. N. CLAYTON and H. H. NEUNZIG, Plant Pathology and Entomology

Name and time of spray	To Control	Materials to use in 100 gal. water[1]
1. Dormant (before new growth starts)	Scales	Dormant oil 83%, 2 to 3 gal.
2. After bloom—before any berries ¼" in diameter	Plum curculio Cranberry fruit worm Cherry fruit worm Leaf spots	Parathion* 15% 1½ lb. or Malathion 25% WP 4 lb. PLUS ferbam 76% 2 lb.
3. 7 to 10 days after No. 2	Same as above for No. 2	Same as above for No. 2
4. 7 to 10 days after No. 3	Leaf spots	Ferbam 76% 2 lb.
5. After all berries are harvested	Leafhoppers Leaf spots	Same as above for No. 2
6. 2 weeks after No. 5	Leaf spots	Ferbam 76% 2 lb.
7. 2 weeks after No. 6	Leafhoppers Leaf spots	Same as above for No. 2
8. Late in August	Blueberry bud mite Leaf spots	Summer oil 96-98% 2 gal. PLUS ferbam[2] 76% 2 lb.
9. Late in September	Blueberry bud mite	Summer oil 96-98% 2 gal.

* Parathion is poisonous, therefore, read and heed labels. Observe interval as shown between last application and harvest; malathion 1 day, parathion 14 days.

[1] Dust as substitute for spray—see N. C. Ent. Info. Note No. 136. If dusts are used, apply when wind not blowing.

[2] Add ferbam last, after spray tank is filled.

"It seems obvious that pesticides are not responsible for all of the incidents attributed to them. There have been numerous instances where pesticide users, or more often their neighbors, in attempts to shift responsibility or collect damages, have knowingly or inadvertently but nevertheless wrongly charged pesticides with a whole host of afflictions to both man and his livestock which have no basis in science, logic or fact."

—Geo. C. Decker, in World Review Of Pest Control, Spring, 1962.

BUNCH GRAPE SPRAY PROGRAM

C. N. CLAYTON and GEORGE D. JONES, Plant Pathology and Entomology

Spray No.	Diseases & Insects To Control	Spray Materials to Use In 100 Gallons of Water	In 3 gals.	Time to Spray
1.	Anthracnose	Copper sulfate (bluestone) ..... 8 lbs. or Liquid lime-sulfur ..... 10 gals. or Dry lime-sulfur ..... 30 lbs.	¾ lb. 2½ pt. 1 lb.	Late in spring on dormant vines before buds start to open.
2.	Scales	Dormant oil 83%	1-3 cups	Do not apply within 14 days of Spray No. 1 Removal of loose bark on canes helpful. Destroy old infested canes.
3.	Black rot Anthracnose Mildews Dead arm	Bordeaux mixture:[a] Copper sulfate ..... 8 lbs. Fresh hydrated lime ..... 8 lbs. or 76% ferbam, sold as Fermate, NuLeaf, Ferradow, etc. ..... 2 lbs.	¾ lb. ¾ lb. 1 oz.	When new shoots are 1 to 2 inches long. See footnote #2, 3, 4 and 5.
4.	Black rot Mildews Anthracnose	Same as in Spray No. 3	Same as in Spray No. 3	When new shoots are 7 to 10 inches long.
5.	Black rot Mildews Anthracnose Grape berry moth Leafhopper Japanese beetle Green June beetle Aphids	Same as in Spray No. 3 plus DDT 50% WP ..... 2 lbs. or Methoxychlor 50% WP ..... 2 lbs. or Sevin 50% WP ..... 2 lbs. or Parathion[b] 15% WP ..... 1 lb. or Malathion 25% WP ..... 4 lb.	As No. 3 plus 2T or 2T 2T 1T 6T	Just before the blossoms open.
6.	Black rot Mildews Anthracnose Grape berry moth Leafhopper	Same as in Spray No. 3 and No. 5		Just after bloom.
7.	Black rot Mildews Anthracnose Grape berry moth Leafhopper	Same as in Spray No. 3 and No. 5		About 10 days after Spray No. 6
	Black rot Mildews Ripe rot Bitter rot	Bordeaux mixture:[a] Copper sulfate ..... 4 lbs. Fresh hydrated lime ..... 4 lbs.	2 oz. 2 oz.	At intervals of approximately 2 weeks until 3 weeks before harvest.

[a] Bordeaux mixture can be prepared by: (1) slowly adding finely powdered copper sulfate to water in the spray tank; (2) during vigorous agitation, add the lime. Add insecticide last. Keep mixture agitated until used.

[b] Parathion is poisonous therefore read and heed labels.

T = tablespoonful.
WP = Wettable powder. EC = Emulsifiable concentrate.

NOTE: 1. In order to avoid excessive residue on fruit at harvest, pesticides should not be applied closer to harvest than indicated below:

Malathion—3 days
DDT—40 days
Ferbam—7 days
Kelthane—7 days
Methoxychlor—14 days
Parathion—14 days
Sevin—1 day

2. A severe scale problem may be avoided by using parathion as the insecticide in the sprays after bloom.
3. Mites and aphids may appear on the shoots most any time during the season. If malathion or parathion is used in the spray program as suggested in Spray #5, control of these pests can be expected. **Parathion should only be used in commercial vineyards and only by those persons who will follow precautions.** While aphids will probably not build up where Sevin is used, it will not control mites. A single application of Kelthane 18½% EC, 1 pt./100 gal. should control mites for remainder of season.
4. Japanese and green June beetles often are severe pests near harvest. Sevin 50% WP, 2 lb./100 gal. or 2 T/3 gal. is used to control these insects and may be used up to 1 day of harvest.

RASPBERRY AND DEWBERRY DISEASE CONTROL

H. R. GARRISS and C. N. CLAYTON, Plant Pathology

Raspberry and dewberry plants are commonly damaged by fungus diseases called anthracnose, leaf spot and cane blight. Affected plants often are severely weakened and produce low yields of poor quality berries. Therefore, the following control measures are suggested.

1. Set disease-free plants.
2. Set plants as far as possible from other cultivated or wild raspberries, dewberries or blackberries.
3. Before setting plants, cut off and burn any old stems, attached to young plants.
4. *In pruning raspberries just after harvest,* remove and burn all old fruiting canes and all heavily diseased ones.
   In pruning dewberries just after harvest, cut off and burn all old and new canes just at or slightly below the soil line.
5. Keep weed growth away from base of plants to promote rapid drying off of plants.
6. Spray the plants thoroughly with material and at time indicated below. Better wetting of canes and leaves with spray results if a spreader, such as Triton B1956 Spreader-Sticker or Dreft is used at 2 or 3 ounces per 100 gallons.

RASPBERRY AND DEWBERRY FUNGICIDAL SPRAY PROGRAMS

When to Spray		Material and Amount to use:		
Raspberry	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.	Liquid lime-sulfur OR Dry lime-sulfur OR Bordeaux mixture made with copper sulfate plus hydrated lime OR Eigetol	1 qt. 12 oz. 3 oz. 3 oz. 1/5 pt.	10 gal. 30 lb. 8 lb. 8 lb. 1 gal.
Just before first blooms open.	Just before first blooms open.	ferbam 76%	6 tablespoonfuls	2 lb.
Apply to new canes when 1½ to 2 feet high.	Just after bloom	Same as above		
Just after harvest.	After harvest and when new growth is about 1 to 1½ ft. long.	Same as above		

NOTE: Liquid lime sulfur—No time limitation.
Dry lime sulfur—No time limitation.
Bordeaux mixture—No time limitation.
Ferbam—40 days of harvest.

PEACH SPRAY PROGRAM

R. L. ROBERTSON and CARLYLE N. CLAYTON

OBSERVE ALL PRECAUTIONS WITH PARATHION AND GUTHION

Name and Time of Spray	Pests to Control	Material per 100 gal. of Spray
DORMANT—After all leaves are off and before buds begin to swell in late winter.	Scale only	Dormant oil spray 2 to 3% actual oil (dilute according to manufacturer's directions)
	Leaf curl only	Liquid lime sulfur 6 gal. OR Ferbam 76% 2 lb. OR Elgetol 2 qts.
	Leaf curl and scale	Oil 3% plus Bordeaux 6-6-100
BLOSSOM	Blossom blight caused by the brown rot fungus	Liquid lime-sulfur (32° Baume) 1 gal. OR Wettable sulfur 6 lb.
Several sulfur sprays at 2 to 3 day intervals during bloom may aid in reducing blossom blight. Wettable sulfurs with less than 80% sulfur may be used at rates to give at least 5 lbs. actual sulfur in 100 gal.		
PETAL-FALL—After all petals are off and before peach is showing.	Plum curculio,[1] Catfacing insects, Brown rot	Wettable sulfur 6 lb. OR Captan 50% 2 lb. PLUS Parathion 15% 2 lb. OR Dieldrin[2] 50% ½ lb. OR Guthion[4] 25% 1¼ lb.
If captan is not used throughout the season, use sulfur through the fourth cover, spray before you start using Captan.		
SHUCK-FALL or FIRST COVER—¾ shucks off.	Catfacing insects, Plum curculio,[1] Brown rot, Scab	Same as Petal fall
Spray thoroughly trunks and larger limbs in addition to spraying tops of trees in each cover spray to aid in control of lesser peach tree borers and peach tree borer.		
SECOND COVER—7 to 10 days later.	Plum curculio, Brown rot, Scab	Wettable sulfur 6 lb. OR Captan 50% 2 lb. PLUS Parathion[3] 15% 2 lb. OR Malathion[5] 50% 4 lb. OR Guthion[4] 25% 1¼ lb.
THIRD COVER—12 to 14 days after second cover.	Plum curculio, Brown rot, Scab	Same as Second Cover.
Use parathion only where curculios are present.		
FOURTH COVER—2 weeks after third cover.	Brown rot, Scab	Wettable sulfur 6 lb. OR Captan 50% 2 lb.
6 - WEEKS - BEFORE - HARVEST—Of each variety.	Plum curculio, Oriental fruit moth, Brown rot	Same as Second Cover
4 - WEEKS - BEFORE - HARVEST—Of each variety.	Plum curculio, Oriental fruit moth, Brown rot	Same as Second Cover
2 - WEEKS - BEFORE - HARVEST—Of each variety.	Plum curculio, Oriental fruit moth, Brown rot	Wettable Sulfur 6 lb. OR Captan 50% 2 lb. PLUS Parathion[3] 15% 2 lb. OR Malathion[5] 50% 4 lb.
PRE-HARVEST—7 to 10 days before harvest of each variety.	Brown rot	Same as fourth Cover OR Sulfur dust or captan dust
Additional sulfur, preferably as dusts, should be applied before and during harvest if brown rot is present or rainy, humid weather occurs.		

[1] Prior to "drop" of wormy peaches, aldrin, dieldrin or heptachlor (2 lb. active ingredient per acre) applied uniformly under the spread of the trees as a spray, dust, or granular material, and disced into the soil immediately after application will control a high percentage of the plum curculio larvae which enter the soil. Indications are that these insecticides will remain effective for several years but the exact time is unknown. This is not a substitute for spraying for plum curculio, but a supplemental measure.

[2] Will not control scale insects or Oriental fruit moth. **Do not use within 45 days of harvest.**

[3] **Do not use parathion within 14 days of harvest.**

[4] **Do not use Guthion within 21 days of harvest.**

[5] **Do not use Malathion within 7 days of harvest.**

STRAWBERRY DISEASE CONTROL

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

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% Wettable Powder—2 lbs./100 gals. water or 2 tablespoons/gal. OR Thiram 65% Wettable Powder*—2 lbs./100 gals. water or 2 tablespoons/gal.

Dusts: Captan 7.5%—40 lbs./A. OR Thiram 5% Dust*—40 lbs./A.

The Albritton variety is relatively resistant to leafspot and scorch. Dixieland, Pocahontas and Tennessee Beauty are quite susceptible. On these three varieties the leaf diseases may be more effectively controlled with Tribasic Copper (53%) than with captan or thiram. On varieties other than Albritton, 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: Bordeaux, 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.
(Commercial plant production)	D-D or Telone	Double fumigate using the above dosag of D-D or Telone	Broadcast treatment	1st application 60 days prior to planting; 2nd application 1 week after the first application.

Control of Virus Diseases

Plant only certified plants.

Red Stele Control

Plant only red stele-free plants where strawberries have never been grown.

FLORAL CROPS DISEASE CONTROL

ROBERT AYCOCK, F. A. HAASIS, 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 zineb 6%	spray dust	1 lb./100 gal. 6% dust	3 times each week during bloom.
		Thylate	thiram	spray	1 lb./100 gal. water	Same as above
	Exobasidium leaf and bud gall	Bordeux	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 garden: Control by hand picking and destruction of galls.)				
	Phytophthora root rot	Formalin	formaldehyde	soil drench	1 part commercial formalin in 49 parts water	½ gal. per sq. ft. of soil well in advance of planting.
Camellia (See Ext. Cir. No. 246)	Sclerotinia flower blight	Terraclor 20% Dust	PCNB	dust	2½ lb./100 sq. ft. (20% dust)	Late December or early January.
		Terraclor 75% Wettable powder		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.
		(Pick up and destroy all fallen flowers; remove old litter and replace with clean pine straw.)				
	Glomerella die-back	Fermate, m Nu-Leaf or Ferradow	ferbam 76%	spray	1½ lb./100 gal. water	Just before & during the period of leaf fall.
Carnation	Alternaria blight	Dithane Z-78 or Parzate	zineb	spray	1½ lb./100 gal. water + spreader	7-day intervals.
		Captan 50W or Orthocide 50W	captan			
	Rust	Dithane Z-78 or Parzate	zineb	spray	2 lb./100 gal. water	10-day intervals, plus proper ventilation.

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 leaves and destroy)	spray	1½ lb./100 gal. + spreader	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 parasitic nematodes	Methyl bromide	methyl bromide		1 to 2 lb./100 sq. ft.	At least 10 to 14 days prior to planting.
	Foliar nematodes	Wettable Parathion 15%	parathion 15%	spray	1½ to 3 lb./100 gal.	7- to 10-day intervals
Dogwood (See Ext. Folder No. 150)	Anthracnose 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	spray	1½ lb./100 gal.	2nd petal fall
		Phaltan 50W	N-trichloro-methylthioph-thalimide 50%	spray	2 lb./100 gal.	3rd mid-summer 4th pre-dormant (after flower buds are well formed)
Gladiolus (See Ext. Cir. No. 373 and Plant Path. Inf. Note No. 22)	Botrytis foliage blight	Dithane Z-78 Parzate Ortho Zineb	zineb	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 maneb 70%	spray	1½ to 2 lb./100 gal. plus spreader	Same as for Botrytis.
	Corm rots-Pre storage (Fusarium, Botrytis, Curvularia)	Dowicide B	sodium trichlorophenate 85%	steep	1¾ 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 100	ethyl mercury acetate and ethyl mercury 2 dihydroxy propyle mercaptide (Hg 2.3%)	steep	2 pt./100 gal.	Treat for 10 minutes just before planting.
		Elcide 73	12% sodium ethyl mercuri thiosalicylate	steep	2 pt./100 gal.	Treat for 10 minutes just before planting.
	For sprouted corms	Captan 50W Orthocide 50W	captan	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.

Floral Crops Disease Control (continued)

Crop	Disease Controlled	Material	Active Ingredients	Method	Concentration	Schedule
Iris (See Plant Path. Info. Note No. 22)	Heterosporium Leaf spot	Dithane Z-78 or Parzate	zineb	spray	2 lb./100 gal. + spreader	Every 10 to 14 days.
	Bulb and stem nematode	Formalin	formaldehyde	long steep	2 qts./100 gal. 110-111° F for 3 hr.	2 hr. pre-steep in water 75° F + Vatsol O. S. at 8 oz./100 gal. Bulbs must be treated before root development begins; this is usually 3 to 4 weeks following early harvest
Dutch Iris	Bulb and stem rot caused by southern wilt organism	Terraclor	pentachloronitrobenzene 10%, 20%, 75%	row	24 lb./acre	Apply 6 lbs. actual ingredient to soil in 1 ft. band on row at (1) planting time, (2) about April 1, (3) April 15, and (4) May 1. Apply as drench or dry application.
				Broadcast 100 to 150 lb./acre		Apply prior to planting. Mix with top 2 or 3 inches 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 *Dowicide B	phenyl mercury acetate, 96.5%	steep	1 lb./400 gal.	Treat for 5 to 15 min. within 3 days after harvest.
			sodium trichlorophenate, 85%	steep	3 lb./100 gal.	Treat for 15 min. within 3 days after harvest.
	Basal rot (Pre-planting)	Mersolite W or Dowicide B	phenyl mercury acetate, 96.5%	steep	1 lb./600 gal.	Treat 5 to 15 min. prior to planting.
			sodium trichlorophenate, 85%	steep	3 lb./100 gal.	Treat for 15 min. just prior to planting.
	Stagonospora leaf scorch	Bordeaux	copper	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.

Floral Crops Disease Control (continued)

Crop	Disease Controlled	Material	Active Ingredient	Method	Concentration	Schedule
Rose (See Ext. Cir. 200 revised)	Black spot	Fermate, Nu-leaf Ferradow	ferbam 76%	spray	2 lb./100 gal.	Apply every 7 to 10 days and twice each week during rainy periods
			ferbam 10%	dust	10% dust	
		Orthocide 50W, Captan 50-W	captan 50%	spray	2 lb./100 gal.	
		Parzate cr Dithane Z-78	zineb zineb 6%	spray dust	2 lb./100 gal. 6% dust	
		Phaltan 50W	N-trichloro-methylthioph-thalimide 50%	spray	1½ lb./100 gal.	Apply every 7 to 10 days and twice each week during rainy periods.
	Powdery mildew	Acti-dione PM	cycloheximide	spray	1 to 2 level tbs.	According to mfr. directions.
		Karathane cr Mildex	dinitro capry phenylcrotonate	spray		
	Combinations of fungicides and insecticides are available for use on Roses					
Snapdragon	Rust	Dithane Z-78 or Parzate	zineb	spray	1½ lb./100	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 plentiful.
Zinnia	Alternaria leaf and flower spot	Bichloride of mercury	mercury	soak	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 and F. A. HAASIS

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 overcome decline, planting sites should be treated and non-infested plants should be set. In addition, treat established plants with fumigants where symptoms of decline are in evidence. In the first instance, decline is avoided by excluding the cause. In the second instance, plant vigor is reestablished by eradicating the parasite responsible for decline. 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 cover 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.

Materials	Rate	Area Treated
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.

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 or Fumazone, 1½ pints per 1000 sq. ft. in enough water to carry the chemical to a 6-inch depth.

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

DISEASES—LAWNS AND TURFS

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.

Brown patch, (bluegrass, tall fescue, St. Augustine) is caused by a soil-inhabiting fungus. *(Rhizotonia solani).* This organism is destructive in established lawns during periods of hot, wet weather. 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:

Material	Active ingredient	Method	Rate per 1000 sq. ft.	Schedule
Terraclor 75%	pentachloro-nitro - benzene	drench	4 oz.	Apply at 7- to 10-day intervals starting in June when conditions for disease development such as high humidity are prevalent and continuing throughout August or until disease is checked.
Terraclor 40%	pentachloro-nitro - benzene	dust	¾ lb.	
Terraclor 20%	pentachloro-nitro - benzene	dust	1 lb.	
Terraclor 10%	pentachloro-nitro - benzene	dust	2 lb.	
Soil Treater X	pentachloro-nitro - benzene + captan	dust	1 lb.	
Tersan	thiram 75%	drench	5 oz.	
Lawn Disease Control	captan + PCNB + cadmium	drench	6 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			Nematodes			Bacterial and Fungus Diseases	Weed Seeds
		Row	Broadcast	Per 100 sq. yds. in Plant Bed	Root Knot	Meadow	Stunt		
D-D Oma-D Vidden D	dichloropropene-dichloropropane mixture	10 gal.	20 gal.	½ gal.	good	good	good	poor	poor
Telone	dichloropropene	8 gal.	16 gal.	½ gal.	good	good	good	poor	poor
Dowfume W-40 Soilfume 40	ethylene dibromide	9 gal.	18 gal.	½ gal.	good	poor	exc.	poor	poor
Dowfume W-85 Soilfume 85		2¼ gal.	4½ gal.	1 pt.	good	poor	exc.	poor	poor
Dorlone	dichloropropene plus ethylene dibromide	6 gal.	12 gal.	3 pt.	fair to good	good	good	poor	poor
Oma Fume D-EDB Field Fume	dichloropropene-dichloropropane mixt. + ethy. dib								
Larvacide Picfume	chloropicrin		28 gal.	½ gal.	good	good	good	good	fair
Various trade names	methyl bromide 98% plus chloropicrin 2%			9 lb. tobacco 18 to 27 lb. vegetables	exc.	exc.	exc.	good	exc.
Nu-Green	urea (field grade)		2400 to 4800 lb.	50 to 100 lb.	fair to good	fair to good	fair to good	fair	fair to good

NOTES: For use of soil treatments in vegetable crops: See Ext. Cir. No. 337 and U.S.A.D. Farmers' Bul. No. 2048. On heavy soils or where excessive organic matter such as sawdust is used in vegetable plant beds the methyl bromide treatment sometimes has caused delayed emergence and stunting of these crops: See Plant Pathology Information Note No. 37.
For treatment of tobacco plant bed soil: See Ext. Folder No. 363 (revised); Field soils: See Ext. Cir. No. 402.
For other uses of the above materials follow mfr. directions.
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.

SWEET POTATO STORAGE HOUSE STERILIZATION

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

Materials	Active Ingredient	Dosage	Method and Requirements
Larvacide	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.
Copper sulfate solution	copper sulfate (bluestone)	1 lb./10 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) Dip or thoroughly spray crates inside and out with the solution. (4) 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 for satisfactory results with fumigation treatments. Maintain temperatures of 70° F. or above during fumigation.

USE CHEMICALS SAFELY — FOLLOW LABEL DIRECTIONS

VEGETABLE CROP SPRAY AND DUST SCHEDULE FOR DISEASE CONTROL

H. R. GARRISS, J. C. WELLS, N. N. WINSTEAD, D. L. STRIDER and L. W. NIELSEN, Plant Pathology

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 first of July.	30 to 40 lbs./A.
Cabbage	Downy mildew (in plant beds)	Dithane Z-78 Parzate Ortho Zineb	zineb	spray	4 lb./100 gal. Apply 3 to 4 days. **7 days before harvest.**	
Cantaloupe	Downy mildew	Tribasic copper sulfate dust containing 5% metallic copper	5% metallic copper	dust	Apply once every 10 days or after each rain beginning around June 10. It may be necessary to move this date up to 7 to 10 days in wet years or it may be moved back 7 to 10 days in dry years. **Close to harvest.**	15 to 20 lb./acre early in season. 35 to 50 lb./acre when plants are larger.
Carrots	Alternaria blight	Dithane M-22 Manzate	maneb	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 (spring crop)	Downy mildew	Tribasic copper sulfate dust containing 5% metallic copper	5%metallic copper	dust	Same as above for Cantaloupe **Close to Harvest.**	
(fall crop)	Downy mildew and anthracnose	Manzate Dithane M-22	maneb	dust or spray	According to manufacturer's label. **No time limitation.**	
		Dithane Z-78 Parzate	zineb			
	Scab (Mt. area)	Manzate Dithane M-22	maneb	spray	At weekly intervals until bloom, then twice weekly through all harvest. **No. time limitation.**	According to mfr. label.
		Dithane A-40 + zinc sulfate	nabam + zinc sulfate			
		Phaltan	folpet			
		Dithane 78 Parzate	zineb		According to manufacturers label. **7 days before harvest.**	
Eggplant	Damping-off (plant beds)	Semesan	hydroxymercurichlorophenol 80% (mercury equivalent 19.0%)	drench	According to manufacturer's label. **No time limitation.**	
		Captan 50-W Orthocide 50W	captan 50%	drench	2 lb./100 gal., apply ½ gal./sq. yd. at 10 day intervals	
Irish potatoes	Late and early blight	Bordeaux mixture* (8-6-100)	8 lb. copper sulfate, 6 lb. hydrated lime, 100 gal. water	spray	When late blight appears and at weekly intervals thereafter for Piedmont and Coastal counties; or when plants are 6 to 8 inches high in Mountain counties. **No time limitation.**	150 to 200 gal./acre when vines are fully grown.

* Not compatible with Sevin

VEGETABLE CROP—SPRAY AND DUST SCHEDULE (continued)

CROP	Disease Controlled	Material	Active Ingredient	Method	Time, Number of Applications and Limitations	Rate of Application
Irish potatoes (con't.)		Tribasic copper sulfate Copper A	53% metallic copper tetra copper calcium oxychloride (45% metallic copper)	spray or dust	Same as above.	Spray: 4 lb. of these materials in their concentrated form (around 45% metallic copper) to each 100 gal./ water. Apply 150 to 200 gal./acre. Dust: 7% metallic copper and apply at 30 to 40 lb./acre.
		C.O.C.S.	copper oxychloride sulfate (55% metallic copper)		**Close to harvest.**	
		Dithane Z-78 Parzate	zineb	spray or dust	Same as above.	According to manufacturer's label.
		Dithane M-22 Manzate	maneb		**No time limitation.**	
Lima beans	Stem anthracnose	Dithane Z-78 Parzate Ortho Zineb	zineb	spray	1st application when disease is first noticed or when plants have started to bloom. Repeat at 5- to 7-day intervals until **7 days before 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 Manzate	maneb			
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.; 2 lb./100 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., rines 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 **Seed treatment only.**	mfr. label.
	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. **No time limitation.**	100 to 150 gal./acre.
	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	spray	According to mfr. label. **Plant bed only.**	

VEGETABLE CROP—SPRAY AND DUST SCHEDULE (continued)

CROP	Disease Controlled	Material	Active Ingredient	Method	Time, Number of Applications and Limitations	Rate of Application
Pepper (continued)	Anthracnose	Dithane M-22 Manzate	maneb 70%	spray	Start when first fruits begin to turn red. 10-day intervals—more often during wet seasons. **No time limitation.**	2 lb./100 gal. water.
		Dithane Z-78 Parzate	zineb	spray		
	Cercospora leafspot	Dithane Z-78 Parzate	zineb	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 M-22 Manzate	maneb	spray	**No time limitation.**	2 lb./100 gal. water.
	Damping-off (Plant beds)	Semesan	hydroxymercuri-chlorophenol 30% (mercury equivalent 19.0%)	Drench	According to mfr. label. **Plant bed treatment**	
		Orthocide 50W Captan 50-W	captan 50%	Drench	10-day intervals. **Plant bed treatment.**	2 lb./100 gal. water; ½ gal./sq. yd.
		Fermate, Nu-leaf Ferradow	ferbam 76%	Drench	10-day intervals.	1 lb./50 gal water; ½ gal. /sq. yd.
		Dowfume MC 2 Pestmaster Bed Fume Kolker Brom-O-Gas	methyl bromide	Fumigation	**Plant bed treatment.**	2 lb./100 sq. ft.
	Downy mildew or blue mold	Fermate, Nu-leaf, Ferradow	ferbam	Spray or dust	1st application when blue mold apears 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: 11.4% ferbam.
		Dithane Z-78 Parzate	zineb	Spray or dust		Spray: 65% zineb, 3 lb. /100 gal. water (2½ level tablespoonfuls/gal.). Dust: 6.5% zineb.
		Dithane M-22 Manzate	maneb	Spray or dust	**No time Limitation.**	Spray: 70% maneb ½ lb. /100 gal. water (1 level tablespoonful/gal.). Dust: 1.4% maneb.

VEGETABLE CROP—SPRAY AND DUST SCHEDULE (continued)

CROP	Disease controlled	Material	Active Ingredient	Method	Time, Number of Applications, and Limitations	Rate of Application
Pepper (continued)	Root knot in field	D-D	dichloropropene-dichloropropane mixture	Fumigation	At least 15 days **before planting.**	20 gal./Acre broadcast; 10 gal./Acre row.
		Dowfume 85 Soilfume 85	ethylene dibromide	Fumigation		4½ gal./Acre broadcast; 2¼ gal./Acre row.
	Southern blight	Terraclor	pentachloronitrobenzene	Transplant solution	**At transplanting.**	4 lb. 75% wettable Terraclor/100 gal. water; ½ pt./plant.
Squash (summer-Mt. area)	Scab	Dithane Z-78 Parzate	zineb	Spray	According to manufacturers label. **7 days before harvest.**	
		Manzate Dithane M-22	maneb	spray	At weekly intervals until bloom, then twice weekly through all harvest. **No time limitation.**	According to mfr. label.
		Dithan A-40 + zinc sulfate	nabam + zinc sulfate			
		Phaltan	folpet			
Tomato	Late blight Early blight Gray leafspot	Manzate or Dithane M-22	maneb	spray	According to manufacturers label. **No time limitation.**	
	Botrytis blight	Captan or Dyrene	captan 2, 4 dichloro-6-(O-chloro-anilino)-triazine	spray	When disease first appears.	2 lb./100 gal. water
	Southern blight	Terraclor	pentachloro-nitrobenzene	transplant solution	**At transplanting**	4 lbs. 75% wettable terraclor/100 gal. water; ½ pt./plant.

VEGETABLE SEED TREATMENT

H. R. GARRISS, J. C. WELLS, N. N. WINSTEAD, D. L. STRIDER and L. W. NIELSEN, Plant Pathology

Crop	Disease Controlled	Materials	Active ingredient	Method	Dosage
Bean (lima & snap)	Seed decay, pre-emergence damping-off	Arasan or Thiram 50 Dust	thiram 50%	dust	1/3 tsp./lb.
Beet Swiss chard	Seed decay, pre-emergence damping-off	Arasan	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 or	hydroxymercurichlorophenol 30% (mercury equivalent 19.0%)	dust	½ tsp./lb.
		Zinc Oxide	zinc oxide	dust	1 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	½ 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	Puratized Agr. Spray + streptomycin sulfate or nitrate	phenylmercuritriethanol-lactate—7.5% and streptomycin sulfate or nitrate (various formulations)	soak	1½ pts./100 gals. and 100 p.p.m. (See label). For mechanical seed treaters or dip, ½ min.
Sweet potato	General	Semesan Bel	12% hydroxymercurinitrophenol plus 2% hydroxymercurichlorophenol	soak	1 lb./7½ gal. water. Soak potatoes for bedding in solution 1 min., dry (in shade) and bed without washing.
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.

SELECTION, ADJUSTMENT, AND CARE OF SPRAYING AND DUSTING EQUIPMENT

J. C. FERGUSON, and 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 124 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 for applying insecticide.
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 foilage 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 GPM @ 50 psi	GPM @ 100 psi	Effect of Abrasive Materials	Repairable
Gear	Bronze	½-1	80	6		Severe	No
6 Nylon Roller* (Standard)	Cast Iron or Ni-resist	¾ and 1½	100-150	5.5	4	Moderate*	Yes
6 Nylon Roller* (Hi Port)	Cast Iron or Ni-resist	¾	150-300	7.5	6.5	Moderate*	Yes
8 Nylon Roller*	Ni-resist or Bronze	¾	200-350	11	9	Moderate*	Yes
Diaphragm	Cast Iron or Ni-resist	¾	100	5	4	Practically none	Yes
Piston		½-1	400-600			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.

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 vigorous bypass from pump. If bypass is not sufficient, 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 nozzle or boom cut-off valve. This will permit full operation of the pressure regulator, and the jet agitator will operate at all times, even when the nozzles are cut off.

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 of cone nozzles. Rate tapers at edge, must be overlapped for even distribution.

2. Even Flat Spray Pattern Nozzle—used for band spraying. Spray pattern uniform throughout pattern. Do not overlap.
3. Boomless (or Cluster) Nozzles—used for wide swath work 30 feet or more. May be single or cluster of nozzles. Spray droplets size vary, and does not give as uniform coverage or as good coverage as other types. Spray pattern more affected by wind than boom type.
4. 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.
5. Solid Cone Spray Pattern Nozzle—used for hand spraying and spot spraying.
6. 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 screens having slightly smaller openings than the nozzle orifice which help to prevent clogging. A line or suction strainer should be used to protect the pump and nozzles from large particles.

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 into about four units 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

pump a small quantity of lightweight motor oil. If these simple things are done prior to storage, equipment will be in good condition for next season.

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

KEEP PESTICIDES IN PROPERLY LABELED CONTAINERS

and

"Read The Label"

CALCULATIONS FOR FIELD AND ORCHARD SPRAYING

R. L. ROBERTSON, Entomology

There are two common methods of recommending dosages of pesticides for the control of pests. One method is to give the number of pounds per acre (lb./A.) of active material required, and the other method is to give the percentage of active material (actual) in finished sprays or dusts to be used. In either case, effective control is dependent upon thorough distribution so that every square inch of plant surface subject to damage is covered with a coating of material sufficiently heavy to protect that surface from attack.

Recommendations for field crops are generally given as pounds of active material per acre for simplicity. Some sprayers deliver 15 to 20 gal. of spray per acre while others deliver 50 to 100 gal. for the same area. The concentration of the spray in this case is not the important factor, but rather the total amount of active material per acre, properly distributed. Orchardists and vegetable growers prefer recommendations given in terms of lb. active material per 100 gal. of spray or as a certain percentage spray. In these instances the amount of material per acre may vary, depending on the size of the plants. When rates are given in this form, it is with the understanding that the spray will be applied until it just begins to run off the leaves.

If the pesticide contains 17, 25, 57, or 72% concentrate, it may be converted to lb. active material by weighing a gal. of this formulation and multiplying this weight by the percentage indicated on the label.

Example 1. 1 gal. of an 18% formulation weighs 10 lb.
Weight of active material is 18% of 10 lb. $(0.18 \times 10) = 1.8$ lb.

Example 2. 1 gal. of a 72% formulation weighs 8 lb.
Weight of active material is 72% of 8 pounds $(0.72 \times 8) = 5.76$ lb.

Whether the rate of application is given in pounds of active material per acre (lb. actual/A.) or in pounds per 100 gallons (lb./100 gal.), the next step is to determine the amount of formulation required to obtain the recommended amount of active material.

Example 3. Recommended rate is 1½ lb./A. of material containing 1.8 lb./gal. Determine amount needed by dividing lb./A. by lb./gal. $(1.5 \div 1.8 = 0.83)$. Therefore 0.83 gal. is required per A.

Example 4. Recommended rate is 8 lb. formulation containing 5.76 lb./gal. $(8 \div 5.76 = 1.39)$. Hence use 1.39 gal.

Measuring cans are calibrated in fluid ounces, pints, or quarts and not in decimal equivalents of gal. Since a gal. contains 128 fl. oz., one can

multiply the decimal equivalent in gal. by 128 and thus obtain the number of fl. oz. necessary.

Example 5. 0.83 gal = 106 fl. oz. (128 x 0.83).

Example 6. 1.39 gal. = 166 fl. oz. (128 x 1.39).

Another method would be to convert the decimal equivalent of gal. to pints and half pints. This may be done by consulting the Table of Decimal Equivalents and taking the closest value to the needed amount.

Example 7. 0.83 gal. = 13 cups or 6½ pints (from table).

Example 8. 1.39 gal. = 1 gal. + 6 cups (or 3 pints) from table.

If the recommendations are given as a percentage spray rather than lb./100 gal., it is often necessary to convert the percentage to pounds. This is a simple procedure if one remembers that a gal. of water weighs 8.34 lbs.; hence 100 gal. weigh 834 lbs.

Example 9. How many lbs. active material will be required for 100 gal. of a 2% spray? 834 lb. x 0.02 = 16.7 lbs.

Example 10. How many lbs. active materials will be required for 100 gal. of a 0.25% spray? 824 lb. x 0.0025 = 2.1 lbs.

Once the weight of material is determined, proceed as in Examples 3 and 4.

When mixing oil sprays, the number of gal. of oil, equivalent to the desired spray, is added to enough water to make 100 gal.

Example 11. Recommended concentration is 3% oil; add 3 gal. of oil to 97 gal. of water.

TABLE OF DECIMAL EQUIVALENTS

Cups	Decimal Equivalent of a Gallon	Cups	Decimal Equivalent of a Gallon
1	0.06	9	0.56
2	0.13	10	0.63
3	0.19	11	0.69
4	0.25	12	0.75
5	0.31	13	0.81
6	0.38	14	0.88
7	0.44	15	0.94
8	0.50	16	1.00

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.

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

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 ÷ 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 OF VARIOUS CAPACITIES

(Brass Nozzles for Non-abrasive Spray Materials)

Capacity Gallons per Hour	TeeJet Nozzle Tip No. (Use with Body No. ¼ TT)			Delavan Nozzle Tip No.			Monarch Nozzle Tip No. (Use with Body No. F97)		
	40 psi	75 psi	90 psi	40 psi	75 psi	90 psi	25 psi	40 psi	80 psi
2	X2			CS 3.5	CS 2.5	CS 2.5	4.6		2.0
3	X3		X2	CS 5		CS 3.5	6.4	4.6	
4	X4	X3		CS 6	CS 5			6.4	4.6
5		X4	X3	CS 6.5	CS 6.5	CS 6	9.0		
6	X6		X4	CS 10				9.0	6.4
8	X8	X6		CS 15	CS 10				9.0
10	X10	X8	X6				18.0		
12	X12	X10	X8	CS 20	CS 15	CS 15		18.0	
14	X14	X12	X10	CS 25					
18	X18	X14	X12	CS 30	CS 25	CS 20			18.0
22		X18	X14			CS 26			
26	X26		X18		CS 33	CS 30			
36		X26							
40			X26						

psi = pounds pressure per square inch.

HOLLOW CONE SPRAY PATTERN FOR WETTABLE POWDERS AND ABRASIVE SPRAYS

Capacity Gallons per Hour	T-Jet Nozzle No. (Use with Body No.* ¼ TT Male) ¼ T Female)						Monarch Non-Clog Nozzle No. (Use with Body Fig. No.** 629 Male) 631 Female)					
	40 psi		80 psi		150 psi		20 psi		40 psi		100 psi	
	Orifice Disc	Core	Orifice Disc	Core	Orifice Disc	Core	Orifice	Lead	Orifice	Lead	Orifice	Lead
4	D2	13					61	61	69	69		
6	D2	23	D2	13			61	53	61	61	69	69
8	D3	23	D2	23	D2	13	53	53	61	53	61	61
10	D2	25	D3	23					53	53		
12	D3	25			D2	23						
					D3	23	49	49				
14	D3	45	D2	25					49	49	61	53
16			D3	25			3/32	3/32				
18					D2	25					53	53
20	D4	25	D3	45	D3	25						
25	D4	45	D4	25	D3	45	1/8	3/32	3/32	3/32	49	49
30			D4	45	D4	25						
35	D6	45					1/8	1/8			3/32	3/32
40					D4	45			1/8	3/32		
50			D6	45			11/64	1/8	1/8	1/8	1/8	3/32
75					D6	45	3/16	5/32			1/8	1/8
100									3/16	5/32	11/64	1/8

psi = pounds pressure per square inch.

* When ordering, specify Body No. (¼ T Female or ¼ TT Male), Orifice Disc No., Core No., and material. Available in brass bodies, tungsten carbide orifice disc (Type DTC), and hardened stainless steel core (Type HSS). Use slotted strainers. Maximum operating pressure 400 psi.

** When ordering, specify Body Fig. No. (629 Male or 631 Female), size of threads (¼ or ¼ pipe threads), Orifice No., Lead No., spray angle and material. Available in brass or stainless steel. Maximum operating pressure 100 psi. No nozzle strainer used. Standard spray angle 80° available with wide angle 120° spray angles on request.

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

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

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TABLE OF WEIGHTS, MEASURES, AND DILUTIONS

A. Weights

28.35 gram = 1 ounce
16 ounces = 1 pound
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
2 tablespoons = 1 fluid ounce
8 fluid ounces = 16 tablespoons = 1 cup
2 cups = 32 tablespoons = 1 pint
2 pints = 64 tablespoons = 1 quart
4 quarts = 256 tablespoons = 1 gallon
128 fluid ounces = 1 gallon

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

Row Spacing	*Length or Distance*
24 inch	7260 yards = 21,780 feet
30 inch	5808 yards = 17,424 feet
36 inch	4840 yards = 14,520 feet
42 inch	4149 yards = 12,446 feet
48 inch	3630 yards = 10,890 feet

D. Tables of Dilutions for Liquids and Dusts

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

Water	*1-400*	*1-800**	*1-1600*
100 gals.	1 qt.	1 pt.	1 cup
50 gals.	1 pt.	1 cup	½ cup
5 gals. *	3 tbs.	5 tsp. *	2½ tsp.
1 gal.	2 tsp.	1 tsp.	½ 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:

Water	*Quantity of Material*					
100 gals. *	1 lb.	2 lb.	3 lb.	4 lb. *	5 lb.	6 lb
50 gals.	8 oz.	1 lb.	1½ lb.	2 lb.	2½ lb.	3 lb.
5 gals. *	3 tbs.	1½ oz.	2½ oz.	3¼ oz. *	4 oz.	5 oz.
1 gal.	2 tsp.	3 tsp.	1½ tbs.	2 tbs.	3 tbs.	3 tbs.

* Example: If a recommendation calls for a mixture of 4 lbs. of a wettable powder to 100 gallons of water, it would take 3¼ oz. (approximately 6½ 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 (tbs.) 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:

Water	*Quantity of Material*					
100 gals. *	½ 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	2½ pints
5 gals.	1 tbs.	1 fl. oz.	2 fl. oz.	2½ fl. oz.	3 fl. oz.	4 fl. oz.
1 gal. *	½ 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					
		¼ lb.	½ lb.	¾ lb.	1 lb.	1½ lbs.	2 lbs.
2.00	0.25	1	2	3	4	6	8
2.64	0.33	¾	1½	2¼	3	4½	6
3.00	0.375	⅔	1⅓	2	2⅔	4	5⅓
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	½	1	1½	2	3	4
6.00	0.75	⅓	⅔	1	1⅓	2	2⅔

*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:				
		½% 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).

Both the chemical and nonchemical methods in use today to control pests are the result of research that has been done by thousands of scientists in state and federal agencies, in industry, in our universities, and in private institutes. These persons include entomologists, plant pathologists, chemists, horticulturists, agronomists, veterinarians, medical scientists, pharmacologists, wildlife specialists, and others. Collectively, they are aware of the areas of both strength and of weakness in all the methods in use. Where the limitations in a given method are serious, two courses of action are followed: One is to eliminate the objectionable feature if possible or to reduce its importance: The other is to find a new material or method that does not have the drawback.

The public can do two things to bring about a better program of pest control. One is to learn more about all aspects of this important subject. The other is to support research, especially on new approaches in which human health hazards are nonexistent or minimal, and to support programs that endeavor to establish the facts about health hazards, if any, in existing control methods.

—From material prepared by the New York State College of Agriculture, Ithaca, and the New York State Agricultural Experiment Station, Geneva, units of the State University, at Cornell University.

"Data compiled by the U. S. Public Health Service reveal that in 1956, of the 152 accidental deaths attributed to pesticides, 94 (62%) involved children under 10 years of age and 78 of these were children under 4 years. Also, the careless storage of household pesticides in pantries and cupboards represented the principal cause of serious illness and deaths due to food contamination."

—Geo. C. Decker in World Review Of Pest Control, Spring, 1962.

DON'T STORE PESTICIDES IN PANTRIES AND CUPBOARDS

PESTICIDE RESIDUE TOLERANCES UNDER PUBLIC LAW 518

The Miller Pesticide Residue Amendment to the Federal Food, Drug and Cosmetic Act (Public Law 518) was enacted July 22, 1954. The Miller Amendment was enacted to protect the public from the danger of consuming products containing excess residues of poisonous materials.

Under legislation provided by the above act and the Federal Insecticide, Fungicide and Rodenticide Act, the U. S. Food and Drug Administration has been establishing certain tolerances in terms of part per million (ppm) of pesticide residues allowable on or in edible products. In determining these residue tolerances the number of applications, dosage used and interval between the last application and harvest have been important factors. It is likewise important that farmers and other users consider these factors when applying pesticides. Improper use may result in seizure of the grower's product in shipment.

Be Sure of Correct Usage—Read Labels. When users of pesticides follow the printed instructions on labels of a pesticide which has been accepted for registration by the U. S. Department of Agriculture, the amount of residue left on a product should be within the established tolerance.

IN CASE OF POISONING

There are five Poison Control Centers in North Carolina. These centers have facilities which provide to the medical profession on a 24-hour daily basis, information concerning the prevention and treatment of accidents involving ingestion of poisonous and potentially poisonous substances. The centers in North Carolina can also provide treatment for accidental poisoning.

NORTH CAROLINA

Charlotte	Poison Control Center Mercy Hosp. 2000 E. 5th St.	EDison 4-6831	James F. Crosby, M.D. Gilbert Colina
Durham	Poison Control Center Duke University Hosp. Box 3024	DUrham 9011 Ext. 3951 or 3806 Night: Ext. 2413	Jay Arena, M.D. Shirley E. Kirkman, M.D.
Jacksonville	Poison Control Center Onslow Memorial Hosp. College St.	7242	S. C. Cox, M.D. Eleanor Williams, M.D.
Mount Airy	Poison Control Center Northern Hosp. of Surry County 830 Rockford St.	STate 6-4151 Ext. 211	Ralph J. Sykes, M.D.
Wilmington	Poison Control Center James Walker Memorial Hosp. 10th & Rankin Sts.	ROger 2-9611 Ext. 240 Night: Ext. 247 or 248	Joseph C. Knox, M.D. M. E. Underwood

North Carolina State College of Agriculture and Engineering of the University of North Carolina and the U. S. Department of Agriculture, Cooperating. State College Station, Raleigh, N. C., R. W. Shoffner, Director. Distributed in furtherance of the Acts of Congress of May 8 and June 30, 1914.