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**EXTENSION BULLETIN 312** 

# Insect and Disease Control

# ON VEGETABLES and TRUCK CROPS

MICHIGAN STATE COLLEGE COOPERATIVE EXTENSION SERVICE EAST LANSING

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# Insect and Disease Control

# on vegetables and TRUCK CROPS

By RAY L. JANES, EDWARD A. ANDREWS, and GORDON E. GUYER

MICHIGAN STATE COLLEGE COOPERATIVE EXTENSION SERVICE

EAST LANSING

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# CONTENTS

	PAGE
Introduction	5
Machinery	5
Concentrate Spraying for Vegetables	5
Amount of Spray or Dust to the Acre	6
Amount of Insecticide to One Gallon of Water	7
Suggestions for Use of the Insecticide Listed	. 7
What Is Meant by "Actual Pounds"	7
Interpreting Control of Diseases Listed	7
Planning a Combined Control Program	. 8
Nematodes	9
Avoid Killing Bees with Insectides	9
Insect and Disease Control Tables	
Asparagus	10
Beans	. 11
Beets	13
Cabbage, Cauliflower, Broccoli, etc	. 14
Carrots	. 16
Celery, Parsnip, and Related Plants	. 17
Corn, Sweet	. 18

Cucumber, Squash, Melons, etc 20
Lettuce
Onions
Peas 24
Potatoes
Tomatoes, Egg Plant and Pepper 28
Turnips, Radishes and Rutabagas 30
Appendix 32
Insecticides 32
Precautions on Use of Parathion 39
Fungicides 42

# Insect and Disease Control on Vegetables and Truck Crops

#### By RAY L. JANES,<sup>1</sup> EDWARD A. ANDREWS,<sup>2</sup> AND GORDON E. GUYER<sup>3</sup>

The rapid development and use of new-type insecticides and fungicides has made the "calendar style" of literature necessary to keep suggestions for proper use up-to-date. The purpose here is to list the chemicals, and the rotation practices, necessary for control. Consequently, many important phases of insect life histories and plant disease symptoms cannot be given. However, for best results in your control program you should secure that information from other literature.

By means of separate tables for each vegetable (or group of vegetables), this schedule outlines carefully the use of insecticides and fungicides for the control of insects and plant diseases. It states the proper use of those materials so that no poisonous residues will be left on food crops. The subject matter in the appendix is an important part of the control sections, and should be read with them whenever referred to in the schedule.

MACHINERY: While little mention is made in this bulletin about the proper use of machinery, its efficient use is very important to any dusting or spraying operation. In many cases, improper use of machinery results in poor control of insects and diseases. Then, too often, the insecticides and fungicides are blamed for the failure of the control program.

In the case of insect control, the location of the pests on the plants determines how the machinery should be adjusted. If the insects are on the underside of the leaves, for example, then the machinery should be adjusted to place the insecticides on those areas. As a general rule, treatments put directly upon insects will give the best results.

CONCENTRATE SPRAYING FOR VEGETABLES: In the past few years, concentrate spraying of orchards for insect and disease control has come into widespread use. We do not know as much about the use of concentrate sprays on vegetables as on fruit trees. Because of this situation, concentrate spraying must be tried and proved before suggestions can be made for its general use on vegetables.

Concentrate spraying reduces the amount of water needed to treat an acre, but applies the regular amount of insecticide, fungicide or both.

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These sprays are made by putting 2, 3, or 4 times the amount of chemical in 100 gallons of water, in comparison with the regular dilute sprays. When twice the amount of chemical is put into a given amount of water—that is called a 2X concentrate spray; three times is called 3X and four times is called 4X. *For example:* If  $1\frac{1}{2}$  pounds of 50% wettable DDT is put into 100 gallons of water to make a regular (dilute) spray then 3 pounds of this same material in 100 gallons of water would make a 2X concentrate spray;  $4\frac{1}{2}$  pounds would make a 3X spray and 6 pounds a 4X spray.

The object of using concentrate sprays is to apply less water (spray) per acre yet use the required amount of insecticide or fungicide. This makes it possible to cover more ground per tankful and avoid extra hauling of water and compaction of soil. *For example:* Suppose it takes 100 gallons of a dilute spray to apply  $1\frac{1}{2}$  pounds of 50% wettable DDT powder to an acre. Then 50 gallons of a 2X concentrate spray used on an acre would apply the desired  $1\frac{1}{2}$  pounds of 50% wettable DDT powder. A 3X concentrate spray would take 33 gallons and a 4X concentrate spray 25 gallons to the acre for the required  $1\frac{1}{2}$  pounds of 50% wettable DDT powder.

Concentrate spraying requires very careful machinery adjustment. For instance the size of the disk openings must be adjusted to the rate of travel and the amount of liquid applied to an acre. Tractor speed will need to be adjusted to your particular kind of sprayer. Concentrate spraying requires that sprayers have good agitators if wettable powders and other like materials are to be used. Even with good agitators it should be remembered that not all materials are suitable for concentrate spraying especially those that have large particles.

It should be kept clearly in mind that the use of concentrate sprays does not change the need for careful, thorough and timely spraying. Effective protection of vegetables against disease and insects requires thorough coverage. In tests to date, low-pressure concentrate applications have not given control equal to that of dilute spray applications. Further research will undoubtedly produce mechanical refinements that will overcome some of these limitations. The chief difficulty with concentrate spraying of truck and vegetable crops is that dense foliage makes it hard to put sprays onto those parts of plants where such insects as aphids, plant bugs, leafhoppers and thrips normally feed. This type of spraying should be done under ideal weather conditions.

AMOUNT OF SPRAY OR DUST TO THE ACRE: The amount of spray or dust necessary to treat an acre varies with the size, shape and density of plant growth. The amount of spray may vary from 50 to 150 gallons of water to the acre; the amount of dust may vary from 20 to 40 pounds. These amounts are about the same regardless of whether an

insecticide or a fungicide is being applied. The aim is to get as complete coverage as possible. Usually, it is not advisable to use over 40 pounds of dust or 150 gallons of spray to the acre.

AMOUNT OF INSECTICIDE TO ONE GALLON OF WATER: Use 1 level tablespoonful of a wettable powder (any strength) to 1 gallon of water, for each pound of insecticide used to 100 gallons of water. In the case of emulsions and liquid concentrates (any strength), use 1 teaspoonful to 1 gallon of water for each pint of insecticide used to 100 gallons of water.

SUGGESTIONS FOR USE OF THE INSECTICIDE LISTED: It is generally not necessary to use more than one insecticide at a time for the control of an insect. Where more than one insecticide is listed in this schedule *use only one*. Also, use only one insecticide in combination with a fungicide. Careful reading of the footnotes and the appendix will aid in making a decision as to which insecticide is best for your purposes.

WHAT IS MEANT BY THE TERM "ACTUAL POUNDS": Insecticides are prepared commercially in varying strengths. DDT dusts, for example, can be purchased in at least three different strengths – such as "3 percent," "5 percent," and "10 percent." Those terms simply mean that in every 100 pounds of commercial dust you purchase, the *actual amount of DDT chemical* is 3, 5 or 10 pounds, respectively.

A recommendation for the control of an insect given in *actual pounds* refers only to the *active* or *killing part* of the insecticide, and not to any other part. In this way, the amounts for any chemical can always be specified accurately, regardless of the manufacturers' relative strengths.

Again taking DDT: For a certain insect the suggested control reads "1½ actual pounds DDT to the acre." This means that you could use either 50 pounds of a commercial "3 percent dust," 30 pounds of a "5 percent dust," or 15 pounds of a "10 percent dust" — and still have a correct application of only 1½ pounds of *actual DDT chemical* to the acre. Or in the case of a "50 percent wettable DDT powder," it would take only 3 pounds to make 1½ *actual pounds* of DDT, because each pound of the powder contains ½ pound of DDT chemical.

INTERPRETING THE CONTROL OF DISEASES LISTED: The sections on diseases are intended as a guide to the identification and control of the important diseases of each vegetable. Only those diseases which past experience indicates are most apt to cause serious losses are included. Detailed and complete descriptions of the symptoms and causes of each disease have not been attempted. It is hoped that the symptoms given will help readers to differentiate between the diseases listed when actually encountered in the field. It has not been possible in most of the schedule for each control suggestion to occur opposite the disease, or all of the diseases, involved. The control program is designed to protect against all of the diseases listed and also against many that are not included.

Fungicides have been referred to by common or chemical names in most instances, especially where the product is marketed under more than one trade name. When a given fungicide is indicated as an effective seed treatment or spray material for a vegetable, it is not implied that it is the only effective fungicide for the purpose. In some instances, effective alternate fungicides are listed. In some others there are acceptable materials on the market that do not appear in this schedule.

PLANNING A COMBINED CONTROL PROGRAM: The information in the tables, footnotes and appendix is intended to help you plan a combined program for the control of both insects and disease. Except where stated otherwise, the insecticides and fungicides listed for use on a particular crop can be mixed without danger of injury to the plants.

As a general rule, this statement may be used to supplement directions given on the manufacturer's labels: With alkaline materials like spray lime or bordeaux—use cryolite, parathion, TEPP, pyrethrum or rotenone with care; or not at all. Lime and bordeaux tend to destroy the effectiveness of those materials.

At present, such crops as asparagus; beans; cabbage; cauliflower; broccoli; sweet corn; peas; turnips; radishes; and rutabagas do not have disease and insect problems which can be controlled with a combined program of insecticides and fungicides. On these crops, therefore, such problems must be controlled *separately*-according to the information given in the schedules.

Crops such as beets; carrots; cucumbers; squash; melons; lettuce, tomatoes; egg plant; and peppers, on the other hand, may have insect and disease problems requiring control at the same time. When such cases arise, combine an insecticide and fungicide according to the particular problem using the recommendations in the respective tables.

A few crops-celery, onions and potatoes, for example-regularly need a combined control program. The tables indicate when either an insect or a disease begins to do damage; combined insect-and-disease control measures should start when the first of those troubles appear. (To illustrate: On potatoes, flea beetles and leafhoppers usually cause damage earlier in the season than the different kinds of blight. Ordinarily, DDT should then be used before some fungicide, such as bordeaux. However, once the potato plants are 6 inches high, it is usually advisable to use both an insecticide and a fungicide at the same time, combining the control measures.)

#### INSECT AND DISEASE CONTROL ON VEGETABLES

NEMATODES: These pests are small eel-like worms. They are so small that it takes a microscope to see them.

They cause damage to vegetables and other plants by feeding upon the roots. Injury to the roots is generally of two kinds. Some nematodes while feeding cause the roots to form swellings. These swellings are called root-knots. Other types of nematodes while feeding cause the roots to slit or crack. The nematodes causing this type of damage are called rootlesion nematodes. Nematode infested plants are not able to grow well because of the damage done to their root system. Nematode damage is often attributed to other causes such as plant disease, plant nutrient. You will find nematodes in all types of soil. They develop best in moist soils. However, they are able to withstand wide ranges of moisture conditions.

There is no complete cure for nematodes. Nevertheless, the following measures will help you grow vegetables in spite of nematodes:

(1) Rotate vegetable crops so that plants injured by nematodes are not grown more often than every three years on the same soil. For instance Irish potatoes, tomatoes, peppers, carrots, celery, onions and other crops are injured by nematodes. Sweet corn usually is not damaged by the same nematodes.

(2) Fallowing a part of the vegetable garden will make it possible to grow crops damaged by nematodes for a year or two. Fallowed ground should be kept free of weeds and as dry as possible.

(3) Soil fumigation is perhaps the best method of reducing nematode damage in vegetable lands. Light sandy and muck soils are easier fumigated than heavier clay soils. The cost of fumigation is high and in many cases cannot be justified, except in cases of high-returning cash crops and in small gardens. Special instructions should be obtained for the use of fumigants for nematode control.

AVOID KILLING BEES WITH INSECTICIDES: Honey bees and many native bees are important to agriculture because they pollinate many fruits, seed plants and some vegetable crops. Plants such as cucumbers, melons and other cucurbits require visits from pollinating insects in order to produce a crop. Because of the importance of bees, insecticides should be used in such a way as to avoid poisoning them.

Following are some points which should be kept in mind in order to minimize the killing of bees when controlling vegetable insects.

(1) As a general rule do not spray plants while in bloom.

(2) Avoid leaving puddles when the spray rig is emptied or cleaned out. Bees will often visit such poisonous puddles in large numbers.

(3) Damage to bees is minimized if spraying is done during the evening or early morning when bees are not flying.

(4) Confine the spray or dust to the crop to which it is applied.

# **ASPARAGUS**

INSECTS:	When to Control	SPRAYS (Amounts to 100 gal. water)*	DUSTS (Percent strength)*	
	Spears	Rotenone (16), 3 lb. of 5% or 3% lb. of 4% concentrate.	Rotenone (16), %%.	
ASPARAGUS BEETLES		TEPP (13), ½ pint of the 50% liquid. Please read the instructions on how	to apply TEPP safely (13)	
	Fern growth. This treat-	DDT (9), 1½ lb. of 50% wettable powder.	DDT (9), 5%.	
	ment is important, but	Lead Arsenate (2), 3 lb. plus a wetting agent.	Calcium arsenate (1), 5%.	
	need for sprays or dusts on the spears.	Rotenone <sup>†</sup> (16), 3 lb. of 5% or 3% lb. of 4% concentrate.	Rotenone† (16), ¾%.	
ASPARAGUS MINER (not common in Michigan)	When miner injury occurs, usually at base of plant.	Nicotine sulfate (12), 1½ pints plus 4 lb. of laundry soap.	Dusts are usually not suitable for control of asparagus miner.	
	Margin of fields	Chlordane (6), 1 actual pound per acre.	Chlordane (6), 5%, (1½ actual pounds per acre).	
		Toxaphene (19), 1½ actual pounds per acre.	Toxaphene (19), 7½% (2 actual pounds per acre).	
GRASSHOPPERS		Aldrin‡ (21), 3 actual ounces per acre.	Aldrin‡ (21), 10% (4 actual ounces per acre).	
	Fern growth	Toxaphene (19), 1½ actual pounds per acre.	Toxaphene (19), 7½% (2 actual pounds per acre).	
DIS	SEASES	CONTROL PRO	OGRAM	
RUST: Reddish lesions appear on stems during the summer turning black late in season. The color of the lesions is imparted by the masses of fungus spores that spread the disease. The fungus over- winters as black spores in the dead stems and fronds lying on the soil.		Martha Washington and Mary Washington varieties are no longer resistant to rust.		
STEM ROT: Gradual death of leaves caused by rot- ting of the stem between root crown and soil level.		At present the cause has not been determined	and there is no control for Stem Rot.	

\*The numerals in parenthesis in this, and all following tables, refer to specific sections of the appendix which should be read carefully. \*Vegetable gardeners may still want to use rotenone in preference to lead arsenate or DDT. Do not use aldrin when it will drift onto pastures where dairy animals are feeding, or where stock is being finished for slaughter.

# BEANS

INSECTS:	When to Control	SPRAYS (Amounts to 100 gal. of water) DUSTS (Percent strength)		
Wh	When they show any ten- dency to increase in	Nicotine sulfate (12), 1 pint plus 4 lb. of Nicotine (12), 4%.		
APHIDS (plant lice)		TEPP* (13), 1 pint of 50% liquid. TEPP* (13), 1%.		
Armos (plane nee)	numbers.	Please read the instructions on how to apply TEPP safely (13).		
		Parathion <sup>*</sup> (13), 1 lb. of 15% wettable Parathion <sup>*</sup> (13), 1%.		
		Please read the instructions on how to apply parathion safely (13).		
Before planting.		Flies are attracted to rotting organic matter and freshly plowed soil. If manure is used, plow it under. Sod should also be plowed under thoroughly.		
BEAN MACCOT BEAN MACCOT Seed treatment using the slurry method (61)†. This method is pre- ferred to the dust treat- ment. Seed treatment using an insecticide dust only (60).	Seed treatment using the slurry method (61) <sup>†</sup> .	Lindane (21), 2 ounces of 25% wettable powder plus thiram (74), 2 ounces to 100 pounds of seed.		
	ferred to the dust treat- ment.	Lindane (21), 2 ounces of 25% wettable powder plus captan (75), 2 ounces to 100 pounds of seed.		
	Lindane (21), 2 ounces of 25% wettable powder to 100 pounds of seed.			
	Treatment for maggot in- fested fields.	Bean seeds are damaged early in the spring when the soil is wet. Reseeding immediately after damage usually gives a good stand.		
GREEN CLOVER WORM (only an occasional pest in Michigan)	As soon as they appear.	Methoxychlor (11), 2 lb. of 50% wettable Methoxychlor (11), 5%. powder.		
Y	When 5 or more leafhop-	DDT <sup>‡</sup> (9), 1½ lb. of 50% wettable powder. DDT <sup>‡</sup> (9), 3%.		
LEAFHOPPERS	pers appear on the underside of the leaves	Pyrethrum (15), ½ pint of a 1% pyrethrins liquid or at manufacturer's directions. 0.1% pyrethrins.		
	For mu2.	Methoxychlor (‡ and ¶) (11), 2 lb. of 50% Methoxychlor (‡ and ¶) (11), 5%. wettable powder.		

<sup>o</sup>TEPP may injure beans, especially if the temperatures are high. Don't apply parathion closer than 15 days before harvest of snap beans. <sup>†</sup>Read section 61 of the appendix for instructions on how to make and use a slurry. <sup>‡</sup>This material should not be put on snap beans bearing pods, because of the residue left on pods at harvest. <sup>§</sup>Watch for an increase of leafhoppers on beans about hay cutting time. Apply treatments to underside of leaves. <sup>¶</sup>This material is not as effective as DDT for control of potato leafhoppers on beans.

## BEANS (continued)

INSECTS:	When to Control	SPRAYS (Amounts to 100 gal. of water)	DUSTS (Percent strength)
Mexican bean beetle	As soon as they appear on the plants, usually on	Rotenone (16), 3 lb. of 5% or 3% lb. of 4% concentrate plus ½ pint of 1% pyrethrins (15).	Rotenone (16), %% plus 0.1% pyrethrins (15).
the underside of the leaves.	Parathion <sup>e</sup> (13), 1 lb. of 15% wettable powder.	Parathion* (13), 1%.	
	Apply treatments without	Please read the instructions on how to	apply Parathion safely (13)
delay to underside of leaves.	Malathion (25), 3 lb. of 25% wettable powder.	Malathion (25), 4%.	

DISEASES	CONTROL PROGRAM
BACTERIAL BLIGHTS: Irregular, water-soaked spots on leaves, stems and pods. When severe, the plant is defoliated or wilted early in the season.	<ul> <li>Plant disease-free seed; in soil that has not grown beans for 3 to 4 years (52). Avoid cultivating when plants are wet.</li> <li>Treat seed (unless already treated with slurry method for Bean Maggot) with 2 ounces of captan (75), 3 ounces of Phygon XL (81), or with 3 ounces of thiram per 100 pounds of seed (60, 69, 74).</li> </ul>
ANTHRACNOSE (fungus): Usually circular sunken lesions on stems and pods with dark margins and lighter colored centers where fungus spores are produced. Leaf infections result in a red colora- tion sometimes referred to as "rutt"	Both the blight bacteria and the anthracnose fungus over-winter in seed and soil and are spread by rain, cultivating equipment during the growing season, and by manure from animals fed on "bean straw." Do not use such manure on fields to be planted to beans.
<ul><li>MOSAIC: Distortion and yellow to green mottling of the leaves.</li><li>ROOT ROTS: A disease complex, caused by several fungi, that has caused considerable loss in the past few years.</li></ul>	Grow varieties resistant to mosaic such as: Dried beans: white—Robust and Michelite. colored—No resistant varieties available. Snap beans—Puregold and Top Crop. There is no control program. Resistant varieties are not yet available.

\*Don't apply parathion closer than 15 days before harvest of snap beans. †Disease-free navy-pea varieties are available as Michigan certified seed; disease-free cranberry and dark red kidney beans are available as California approved seed; disease-free snap bean varieties are available from commercial seed companies.

# BEETS

INSECTS:	When to Control	SPRAYS	(Amounts to 1	100 gal. of water)	DUSTS	(Percent strength)
CUTWORMS	Beets usually damaged shortly after they come up. Beet leaves cut to the ground.	DDT* (9), Poison b be eat	1½ lb. of 50% ran bait (3). en within 30	wettable powder. Use baits instead of days.	DDT* (9), DDT where	5%. beet leaves are to
Flea beetle	As soon as damage is noted on leaves.	DDT‡ (9), Rotenone† ( 4% conce	1½ lb. of 50% (16), 3 lb. of entrate.	wettable powder. 5% or 3% lb. of	DDT‡ (9), Rotenone†	5%. (16), %%.
DIS	SEASES			CONTROL PRO	GRAM	
BLACK ROOT (Aphanomyces): Blackened stems dur- ing 2-4 leaf stage. Later rotting tap root and darkening of the tissues. DAMPING-OFF (soil fungi): Pre-emergence rotting of young plants and wilting and death of young plants shortly after emergence.		Treat with Phygon X	captan (75) 1 XL (81) per 1	ounce, 1.6 ounces 10 pounds of seed.	thiram (60,	69, 74), or 1 ounce of
		Rotate 2 to	3 years (52)			
		Spray with	8-8-100 Borde	eaux every 10 days	(63 and 79).	
LEAF SPOT (Cercospora purple borders. Later	a): Brown leaf-spots with spots turn grey.	Plant on w developed	ell-drained so	il. Black root resis	tant sugar b	eet varieties are being

<sup>o</sup>Treatment can be sprayed or dusted over the top of the rows. Wash leaves thoroughly when used as greens. (Note use of baits for cutworm control.) †Use rotenone-not DDT-if the leaves of the beets are to be eaten for food within 30 days of treating. Repeat with rotenone if the beetles are not controlled satisfactorily. ‡Wash leaves thoroughly when used as greens after using DDT. If any doubt about the residue, use rotenone.

# CABBAGE, CAULIFLOWER, BROCCOLI, ETC:

INSECTS:	When to Control	SPRAYS (Amounts to 100 gal. of water)	DUSTS (Percent strength)		
Cabbage maggot	Transplant water treat- ments. Put in plant- setting water and apply around roots at the time plants are being set in the field. Treatments applied to sur- face of soil. Apply to the soil next to the stem when the plants are set out. Repeat 4 times at	Chlordane (6), 1 pint of $45\%$ or $\%$ pint of $72\%$ or 2 pounds of $50\%$ wettable powder in 100 gallons of water. Apply 1/3 pint of treatment to each plant. An application to the surface of the soil should be made 10 days after the plants are first treated.			
		Aldrin (23), 1½ pints of 25% emulsion or 1½ pounds of 25% wettable powder in 100 gallons of water. Apply 1/3 pint of treatment to each plant. An applica- tion to the surface of the soil should be made 10 days after the plants are first treated.			
		Chlordane (6), 2 lb. of 50% wettable powder.	Chlordane (6), 5% - OR - Aldrin (23), 2½%,		
		Aldrin (23), 1½ lbs. of 25% wettable powder or 1½ pints of 25% emulsion.	These dusts can be used to treat cabbage in both seed beds and fields.		
7-day in	7-day intervals.	Calomel* (4), 1 ounce to 8 gallons of water.	Calomel* (4), 5% plus 95% talc.		
		Corrosive sublimate <sup>+</sup> (5), 1 ounce to 10 gal- lons of water.	Dusts of corrosive sublimate are not used.		
L CONTER CARRACE	When they appear.	DDT <sup>‡</sup> (9), 1½ lb. of 5% wettable powder.	DDT‡ (9), 3%.		
worm (white butter- fly)	(filled die) appear	Rotenone§ (16), 3 lb. of 5% or 3% lb. of $4\%$ concentrate.	Rotenone§ (16), ¾ or 1%.		
		Pyrethrum§ (15), ¾ pint of a 1% pyrethrins liquid or at manufacturer's directions.	Pyrethrum§ (15), a minimum of 0.15 of 1% pyrethrins.		
CABBAGE LOOPER and DIAMOND-BACK MOTH	When they appear.	Same as for imported cabbage worm.	Same as for imported cabbage worm.		

\*Calomel is not as dangerous to use as corrosive sublimate. For control of maggots damaging turnips and radishes, see the section on turnips.

<sup>†</sup>Corrosive sublimate is very dangerous to use. Read section 5 of the instructions in the appendix. <sup>‡</sup>DDT is excellent for the control of worms on cabbage and Cole crops. However, it should not be used after the heads start to form. It should not be put on the heads of cauliflower or broccoli at any time. Repeated use of DDT tends to build up the waxy cabbage aphid populations on cabbage and other plants in this group.

Both rotenone and pyrethrum should be applied to both sides of the cabbage leaves. The eggs of the imported cabbage worm are laid on the underside of the leaves; those of the looper on the upperside. Doing this one thing will get more worms killed with these materials.

# CABBAGE, CAULIFLOWER, BROCCOLI, ETC. (continued)

INSECTS:	When to Control	SPRAYS (Amounts to 100 gal. of water)	DUSTS (Percent strength)
CABBAGE APHID*	When they appear. Be-	Nicotine sulphate (12), 1½ pints plus 6 lb. of laundry soap.	Nicotine (12), 4%.
(plant lice)	plant lice) cause of the waxy na- ture of the cabbage leaf, dusts have in	TEPP (13), 1 pint. Please read the instructions on how	TEPP (13), 1%. to apply TEPP safely (13).
many cases been su- perior to sprays. (Add stickers to sprays.)	Parathion (13), 1 lb. of 15% wettable pow- der. Please read the instructions on how to	Parathion (13), 1%. apply parathion safely (13).	

DISEASES	CONTROL PROGRAM
CLUB ROOT <sup>†</sup> (a slime mold, Plasmodiophora): Swelling and deformity of roots.	Rotate crops so that cabbage and related vegetables are not planted on the same land oftener than once in 5 years. If club root occurs, wait 8 years before replanting in the field (52). Treat plant bed soil (51, 53-56).
<ul><li>WIRE STEM (Rhizoctonia): Dark colored, tough, woody stems.</li><li>BLACK LEC (Phoma): Sunken lesions that eventu- ally girdle the stem. Circular brown spots on leaves.</li></ul>	Treat seed by immersing in water at 122°F. for 25 minutes (15 minutes for cauliflower and broccoli) (57). Then dust (60) dry seed with $\frac{2}{3}$ ounce of either Semesan (68), Phygon XL (81), or Arasan (69 and 74).
BLACK ROT (bacteria): Vascular bacteria blight leaves and cause a blackening of veins.	Wet soil at base of seedlings with a 1/2000 corrosive sublimate solution (1 ounce dissolved in 15 gallons of water) (59). Repeat applications weekly until they are transplanted to the field.
Mosaic (virus): Yellow and green mottling of leaves of all crucifers. Mosaic infected cabbage heads frequently have black dead specks through- out.	Rogue and destroy any plants showing mosaic symptoms.

•Heavily infested individual cabbage, cauliflower or other plants in this family should be buried immediately after finding them. Aphids spread from these to other plants.

†A club root resistant cabbage variety is being developed at the Wisconsin experiment station which should be available in a few years.

# CARROTS

INSECTS:	When to Control	SPRAYS (Amounts to 100 gal. of water)	DUSTS (Percent strength)
CARROT CATERPILLAR*	When it appears.	DDT (9), 1½ lb. of 50% wettable powder.	DDT (9), 5%.
		Rotenone (16), 3 lb. of 5% or 3% lb. of 4% concentrate.	Rotenone (16), %%. Apply 20 to 25 pounds to the acre.
Six-spotted	Treat field margins when	Parathion (13), 1 lb. of 15% wettable powder plus 1 qt. of 25% DDT emulsion.	Effective dust treatments are not
LEAFHOPPER <sup>†</sup>	carrots come up.	Parathion (13), 1 lb. of 15% wettable powder plus 2 lbs. of 50% wettable DDT	available.
Both field and field		Please read instructions on how to a	upply parathion safely (13).
margins must be treat- ed for successful con- trol of six-spotted leaf- hopper.	Start when plants are 1 inch high.	DDT (9), 3 lb. of 50% wettable powder, 5 times at 7-day intervals.	DDT (9), 5%. Apply at 40 lb. to the acre, 5 times at 7-day intervals.
		Parathion (13) 1 lb. of 15% wettable para- thion, 5 times at 7-day intervals. <i>Please read instructions on how to a</i>	Parathion (13), 1%. Apply 5 times at 7-day intervals. apply parathion safely (13).

DISEASES	CONTROL PROGRAM
LEAF SPOTS (fungi): Leaves turn yellow and then brown or are covered with grey to brown spots.	Rotate crops so that carrots are not planted on land that grew carrots the previous year (52).
YELLOWS (virus): Twisting, stunting and yellowing of tops, Abnormal development of hairy roots	When leaf spots appear, spray with fixed copper at 2 pounds metallic copper per 100 gallons of water (64, 77, 78). Repeat spraying at 1-week to 10-day intervals.
below ground. Virus is transmitted by leafhoppers.	Control leafhoppers as directed to prevent virus diseases.

This insect is not too prevalent in Michigan. †This insect carries aster yellows to the carrot. If Bordeaux is used as a fungicide for the control of leaf spots in combination with an insecticide for control of 6-spotted leafhopper, use 4 pounds of DDT, 50% wettable powder instead of the 3 pounds when used without a fungicide. When using para-thion with Bordeaux or fixed coppers, use 1½ pounds of the 15% wettable powder and apply immediately for best results.

INSECTS:	When to Control	SPRAYS (Amounts to 100 gal. of water)	DUSTS (Percent strength)
Aphilds*	When they appear and	Nicotine sulfate (12), 1 pint plus soap 4 lb.	Nicotine (12), 4%.
	colonies.	TEPP (13), 1 pint. Please read the instructions on how to	TEPP (13), 1%. 2 apply TEPP safely (13).
TARNISHED PLANT BUGS	When they appear.	Pyrethrum († and §) (15), ½ pint of 1% liquid or at manufacturer's directions.	Pyrethrum († and §) (15), 0.2 or 0.3% pyrethrins.
		Parathion (‡ and §) (13), 1 lb. of 15% wettable powder.	Parathion (‡ and §) (13), 1%.
		I lease read the instructions on now it	apply parallillon safely (13).
Celery leaf tier <sup>†</sup>	Usually appears within a few weeks of harvest.	Pyrethrum (15), ½ pint of 1% liquid or at manufacturer's directions.	Pyrethrum (15), 0.2 or 0.3% pyre- thrins.
	1. A	For satisfactory control, these treatment.	s must be repeated in ½ hour.
DISEASES¶		CONTROL PRO	GRAM
Damping-off (soil fungi)		Rotate—3 to 4 years (51, 52).	
		Plant seed that has been held at room temperature for 1 year.	

# CELERY, PARSNIP, AND RELATED PLANTS

•Most growers wait too long before attempting to control aphids. For best results, insecticides should come in direct contact with the body of the aphid. †There is no tolerance for DDT residue on celery at harvest. The celery leaf tier usually causes trouble around or within a few weeks or days of harvest. DDT cannot be used within 45 to 60 days of harvest without leaving residue.

Parathion should not be applied to celery later than 21 days before harvest. In cases where the growth is exceedingly heavy, 30 days would be a safer margin between application and harvest. The residue problems with parathion should be strictly respected.

Bordeaux destroys the efficiency of parathion and pyrethrum. When it is necessary to use either with bordeaux, double the amount of pyrethrum-and if insect populations are heavy, parathion also. Apply the combinations immediately after mixing. However, avoid such use if possible.

[Dusting as indicated in the schedule has been more effective for control of celery diseases in Michigan than spraying.

### CELERY, PARSNIP AND RELATED PLANTS (continued)

DISEASES	CONTROL PROGRAM	
EARLY BLIGHT (Cercospora): Causes large irregu- lar brown leaf spots on celery.	Spray with 8-8-100 Bordeaux <sup>o</sup> once a week (63 and 79) when plants are estab- lished in field and begin to produce new foliage.	
LATE BLIGHT (Septoria): Causes small, circular leaf	- OR $-$ Dust with zineb, 7%, plus 25-30% sulfur (67, 69, 73 and 80).	
spots on cercif.	Treat soil of the seed bed (51, 53-56, 68, 76).	
YELLOWS OF CELERY (Fusarium): Wilting, yellow- ing and stunting of the plants. Young plants are frequently killed by the fungus as in damping-off.	Grow yellows resistant varieties such as: Michigan Golden, Cornell 19, and Michi- gan State Green Gold. Pascal varieties have been moderately resistant, but need further testing.	

# CORN, SWEET

INSECTS:	When to Control	SPRAYS (Amounts to 100 gal. of water)	DUSTS (Percent strength)
European corn borer	EUROPEAN CORN BORER EUROPEAN CORN BORER UROPEAN CORN BORER EUROPEAN CORN BORER	DDT (9), 3 lb. of 50% wettable powder plus ½ lb. of a wetting agent (16). Apply 100 gallons to the acre.	DDT (9), 5% dust, 40 lb. to the acre; or DDT, 10% dust, 20 lb. to the acre. The first treatments take less dust than listed here.
		DDT (9), emulsions, 1½ lb. to the acre of actual DDT. Use only those emulsions that will not injure the foliage.	
		Ryania (17), 6 lb. of the 100% concentrate plus 1/3 lb. of wetting agent (16).	Ryania (17), <b>4</b> 0% dust at 30 to <b>4</b> 0 lb. to the acre.
		Rotenone (16), 3 lb. of 5% or 3% lb. of the 4% concentrate. Rotenone is suggested as a spray or dust	Rotenone (16), 1%. only for use in small home gardens.

\*Bordeaux tends to destroy the effectiveness of parathion, pyrethrum, and TEPP. When it is necessary to use pyrethrum or TEPP with bordeaux, double the amounts and use immediately after mixing. It may also be necessary to double the dosage of parathion with bordeaux, if insect populations are heavy. However, the combination of any of the three with bordeaux should be avoided whenever possible.

INSECTS:	When to Control	SPRAYS (Amounts to 100 gal. of water)	DUSTS (Percent strength)
Corn earworm*	Apply first treatment when earliest silks are 1 day old. Apply a second treatment 2 days after,	DDT (9), 3 qt. of 25% emulsion plus 2½ gallons of white mineral oil of 65 to 95 seconds saybolt viscosity. This is the preferred treatment for	DDT (9), 5% or 10%. (Sprays are preferred.)
	the first application.	DDT (9), 3 lb. of $50\%$ wettable powder plus $1/3$ lb. of a wetting agent (16).	DDT (9), 5% or 10%. (Sprays are preferred.)
WIREWORMS	Soil treatment. Apply chlordane or aldrin, or	Chlordane‡ (6), 15 lb. of 40% wettable powder to the acre.	Chlordane‡ (6), 120 lb. of 5% dust to the acre.
	fertilizers containing these materials evenly to the surface and disk	Aldrin (21) apply 8 to 12 lb. of 25% wettable powder to the acre. Use 8 lb. for mineral and 12 lb. for muck soils.	
	into the soil.	Small garden plots can be treated with DE For amounts to use, follow manufacture's corn should not be planted following sod or Drainage aids in controlling wireworms.	0 (7) or ethylene dibromide (10). s directions. On large fields, sweet badly infested lands, unless treated.
SEED-CORN MAGGOT	Soil preparation. (Cold wet weather favors this insect.)	Plow fields top dressed with manure or other organic matter to avoid attracting flies.	
	Seed treatment using the slurry method (61).	Lindane (21), 2 ounces of the 25% wettable to 100 pounds of seed.	powder plus thiram (74), 2 ounces
	This method is pre- ferred to the dust treat- ment.	Lindane (21), 2 ounces of the 25% wettable powder plus captan (75), 2 ounces to 100 pounds of seed.	
	Seed treatment using a dust (60).	Lindane (21), 2 ounces of 25% wettable pow	wder to 100 lb. of seed.
	After maggot damage has been done to fields.	Usually replanting immediately after a planting of corn seed has been damaged is seed-corn maggots, assures a good stand. Seed should be planted as shalle as possible to insure quick germination and growth	

### CORN, SWEET (continued)

°It is best to control corn borer and corn earworm with the same treatments. The treatments for first brood corn borer should begin when the eggs commence to hatch. The treatments for corn earworm are put directly on the silk. <sup>†</sup>One of the serious features of wireworm feeding is the damage to newly planted seeds which prevents them from coming up. <sup>‡</sup>Chlordane-treated corn fields should not be treated again with chlordane for 3 years, or planted to root crops during that same length of time.

CORN, SWEET (continued)

DISEASES	CONTROL PROGRAM
SMUT (Ustilago): Causes deformities and swelling on leaves, stalks and ears that later are filled with a fine black powder.	3 year rotation (52). Early varieties are very succeptible. Late sweet corn varieties are moderately resistant.
STALK ROT (soil fungi): Weakens stalks resulting in breakage before corn is ripe. Most important in field corn.	Treat seed with 4 ounces of Arasan to 100 pounds of seed (60, 69 and 74), or 4 ounces of Phygon XL (81). Most seed on the market has been treated by producers.
BACTERIAL WILT: Young plants are wilted and stunted, eventually drying up. Larger plants have long, wilted, pale green streaks on leaves. Only nubbins or no ears at all are produced.	Grow Golden Cross Bantam or other wilt-resistant varieties. In general, the early maturing varieties are the more susceptible.

# CUCUMBER, SQUASH, MELONS, ETC.

INSECTS:	When to Control	SPRAYS (Amounts to 100 gal. of water)	DUSTS (Percent strength)
Cutworms*	Apply on soil just before cucumbers come up.	DDT (9), 2 lb. of 50% wettable powder. Toxaphene will injure these plants-not rea	DDT (9), 5%. commended for cutworm control.
	After plants are up.	Poison bait (3).	
Melon Aphid <sup>†</sup>	Before they have curled the leaves.	TEPP (13), 1 pint of the 50% liquid. Please read the instructions on how	TEPP (13), 1%. to apply TEPP safely (13).
		Nicotine sulphate (12), 1 pint plus 4 lb. of laundry soap.	Nicotine (12), 4%.
Squash bug‡	When they appear and before they become too	Pyrethrum (15), % pint of a 1% pyrethrins liquid or at manufacturer's directions.	Sabadilla (18), 10, 15 or 20%. 20% preferred.
	numerous. Repeat treat- ments as necessary.		Pyrethrum (15), a minimum of 0.2% pyrethrins should be used.

•Cutworms feed at night. Treatments should be applied in the evening and not in the morning. †It is not unusual for the melon aphid to start building up on a few plants in the field. Heavily infested individual plants should either be treated to eliminate the aphids or buried on the spot. ‡Such materials as chlordane will kill squash bug, but they may also injure the plants.

Squash vine $\operatorname{Borer}^{\circ}$	Begin when the vines start to run. Cover stem at ground level and out for about 30 inches. Four treatments, 7 days apart,	2 lb. plus 2-3-100 Bordeaux (79). Methoxychlor (11), 2 lb. of 50% wettable powder. Rotenone (16), 3 lb. of 5% or 3% lb. of 4%	Calcium arsenate (1), 5% in gyp- sum.         Methoxychlor (11), 5%.         Rotenone (16), % or 1%.
	may be needed.	concentrate.	
SEED-CORN MAGGOT	This insect is best control. should be taken when pr surface of the seed bed.	led for the present at least by immediately reparing the seed bed to avoid having manure Seed planted as shallow as possible in a war:	replanting a damaged field. Care or fermenting green manure at the m seedbed usually escapes damage.
STRIPED BEETLE and	When plants emerge from	Methoxychlor (11), 1½ lb. of 50% wettable powder. Methoxychlor may injure melons. No evidence	Methoxychlor (11), 3 or 5%. 3% preferred. e of injury to squash or cucumbers.
BEETLE <sup>*</sup>	weekly intervals.	Calcium arsenate (1), 2 lb. plus 2-3-100 Bordeaux (79).	Calcium arsenate (1), 5%.
		Rotenone (16), 3 lb. of 5% or 3% lb. of 4% concentrate.	Rotenone (16), % or 1%.
			Cryolite (20), 25% plus talc or gypsum.
DISEASES		CONTROL PRO	GRAM
BACTERIAL WILT: Sudden wilting of green vines. FUSARIUM WILT: Wilting accompanied by brown lesions on vines.		Control beetles as given. This is the only e 3 to 4 year rotations (52). Treat plant bed so Immerse seed in a solution of mercuric chlor	ffective treatment for bacterial wilt. bil (51, 53, 54, 55, 76). ride (58, 59), 1 ounce in 8 gallons
SPOT ROT, sometimes called SCAB (fungus): Small sunken spots on fruit sometimes having a greenish moldy growth		of water, for 5 minutes. Remove and rin 10 to 15 minutes. Dry seed and dust (60) or <sup>1</sup> / <sub>3</sub> ounce Phygon XL (81) to 10 lb. of s	se thoroughly in running water for with $\frac{1}{3}$ ounce thiram (69 and 74), seed.
ANGULAR LEAF SPOT (bacteria): Water-soaked spots on leaves that later become dried and often drop out.		Start spraying when vines are 8-10 inches long copper at 1½ to 2 pounds metallic copper and 77), at 2 pounds per 100 gallons of 8 to 10 inches long and repeat each week	g and repeat once a week with fixed (64, 77, and 78), or zineb (69, 73, water. $-OR - Dust$ when vines are with a 5 to 7% fixed copper (80).
MOSAIC (virus): Yellow and green mottled, dis- torted leaves. White, warty cucumber fruit. The virus is transmitted by aphids and by pickers handling the plants.		Control aphids as given. Resistant varieties: Melons resistant to fus Improved types will be released within tw MR-17 is resistant to mosaic and SR-6 to s	sarium are available commercially. o or three years. Cucumber variety pot rot.

#### CUCUMBER, SQUASH, MELONS, ETC. (continued)

\*Squash vine borer must be controlled before the worms bore into the vines.

<sup>†</sup>The striped and 12-spotted cucumber beetles carry (to cucumber plants) a disease called bacterial wilt. Bacterial wilt does not show until after the beetles have fed on the plants, and is usually worse in hot weather. <sup>‡</sup>The bacteria are carried in the bodies of cucumber beetles and in some perennial weeds.

# LETTUCE

INSECTS:	When to Control	SPRAYS (Amounts to 100 gal. of water)	DUSTS (Percent strength)
Six-spotted leafhopper (Causes aster yellows on lettuce)	Treat field margins 2 days before lettuce comes up	Parathion (13), 1 lb. of 15% wettable pow- der plus 1 qt. of 25% DDT emulsion.	Parathion (13), 1% plus DDT (9), 10%.
	or is transplanted. Re- peat treatments once a week.	Parathion (13), 1 lb. of 15% wettable pow- der plus 2 lb. of 50% wettable DDT (9), powder.	This dust is not as effective as the sprays.
		Please read the instructions on how to	apply parathion safely (13).
	Start when plants are 1 inch tall or when trans- planted. Both field and	Parathion (* and †) (13), 1 lb. of 15% wet- table parathion powder. Please read the instructions on how to	Parathion (* and †) (13), 1%. apply parathion safely (13).
	field margin treatments necessary.	Pyrethrum <sup>*</sup> (15), ¾ pint of 1% emulsifiable liquid or at manufacturer's direction.	Pyrethrum <sup>*</sup> (15), containing 0.2% pyrethrins. Or pyrethrum (15), plus piperonyl cyclonene (14).
DISEASES		CONTROL PRO	GRAM
DAMPING-OFF (soil fungi):		Dust 2 or 3 weeks before harvest underneath only partially control "Drop" (65).	the plants with Ceresan. This will
ing with those nearest soil.			
DROP (Sclerotinia): Attacks leaves resulting in a wet, slimy rot of entire head.		4-year rotation $(52)$ in the field, and treat plant	bed soil in greenhouses (51, 53-56).
YELLOWS (virus): Turns plants yellowish and pre- vents normal formation of heads.		Yellows transmitted by leafhoppers; control parathion.*	hoppers as above. See footnote on

<sup>&</sup>lt;sup>o</sup>Parathion is more effective for control of 6-spotted leafhoppers than is pyrethrum. †The first parathion treatment should be applied when the plants are set in the field. Repeat treatments at 7- to 10-day intervals. There is little gained by applying treatments later than approximately 30 days before harvest. It takes about this length of time for the disease to develop (symptoms to appear). Early treatments are the important ones. Parathion should not be applied to lettuce later than 30 days before harvest. The residue problem with parathion should be strictly respected.

# ONIONS

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INSECTS:	When to Control	SPRAYS (Amounts to 100 gal. of water)	DUSTS (Percent strength)
Onion maggot <sup>*</sup>	Soil treatment before planting. Apply to top of soil and disk in. For dry onions only.	Dieldrin (22), 8 lb. of 25% wettable powder.	Dieldrin (22), 1%%. Use 135 lb. to the acre.
Furrow treatment <sup>†</sup> . Apply to the open furrow im- mediately after seeding but before the furrow is closed. Spraying or dusting may be needed 30 days after this treat- ment in order to ade- quately protect the onions. For dry onions	Dieldrin (22), 3 lb of 25% wettable powder.	Dieldrin (22), 1½% using 50 lb. to the acre.	
	Spraying or dusting treat-	Dieldrin (22), 1½ lb. of 25% wettable pow- der. Repeat at 7-day intervals.	Dieldrin (22), 1.5% Repeat at 7-10-day intervals.
	ments applied to surface of soil. Apply when onions first come up. <i>For dry onions only</i> .	Chlordane (6), 2 lb. of 50% wettable pow- der. Repeat 2 to 4 times at 7-day intervals. Chlordane-treated onion fields should not be 3 years or planted to root crops durin	Chlordane (6), 5%. Repeat 3 or 4 times at 7-day intervals. treated again with Chlordane for g that same length of time.
		<ul> <li>Parathion (13), 1½ lb. of 15% wettable powder. Repeat 3 to 5 times at 7-day intervals.</li> <li>Please read the instructions on how to approach of the should not weed by hand in parathion-treated</li> </ul>	Parathion (13), 1 or 2% dust. (2% preferred.) Repeat 4 or 5 times at 7-day intervals. oly parathion safely (13). Workers fields for 48 hours after application.
	For bunch onions.	Rotenone <sup>‡</sup> (16), 3 lb. of 5% or 3% lb. of 4% concentrate. Repeat every 5 days for 6 or 7 treatments.	Rotenone‡ (16), ¾ or 1%. Repeat every 5 days for 6 or 7 treat- ments.

\*Once the maggots are inside the onion plants, there is not much that can be done by using insecticides. Hence, treatments must be started early and continued at regular intervals.

<sup>†</sup>Chlordane should not be used for the furrow treatment. <sup>‡</sup>Rotenone is not as good as parathion for the control of onion maggot affecting bunch onions. Repeat rotenone treatments immediately after heavy rain. Rotenone, unlike chlordane, is safe from objectionable residues on *bunch onions;* chlordane should be used for dry onions only.

INSECTS:	When to Control	SPRAYS (Amounts to 100 gal. of water) DUSTS (Percent strength)
Onion thrips*	Start treatments before the plants are 6 inches	Parathion (13), 1 lb. of 15% wettable pow- der. Please read the instructions on how to apply Parathion safely (13)
	intervals.	Dieldrin (22), 1 lb. of 25% wettable powder. Dieldrin (22), 1%.
		DDT (9), 3 lb. of the 50% wettable powder. DDT (9), 5%.
DISEASES		CONTROL PROGRAM
SMUT (Urocystis): Lesions on plants contain black masses of spores. Infections occur after germina- tion of seed. Plants frequently killed before or shortly after emergence.		Mix 1 pound of thiram (69, 74) with 4 pounds of seed in the planter and plant mixture. Set planter at next-larger opening than for seed alone.
Downy MILDEW (Peronospora): Starts as purplish mold spots on leaves which later dry and turn white.		Dust weekly with 7% zineb, plus 25-30% sulfur (67, 69, 73, 80) when plants are well established.
PINK Roor (Phoma): Stunted plants with shrivelled, pink roots. 3-year rotation (52). Methods o are not known.		3-year rotation (52). Methods of eliminating the pink root fungus from the soi are not known.

# PEAS

INSECTS:	When to Control	SPRAYS (Amounts to 100 gal. of water)	DUSTS (Percent strength)
Pea aphid <sup>†</sup>	At first appearance.	Malathion (25), 1½ pints of 50% emulsion or 3 lb. of 25% wettable powder.	Malathion (25), 4% dust, 30 lb. to the acre.
(continu	ued on next page)	Nicotine sulfate (12), 1 pint plus 4 lb. of laundry soap.	Nicotine (12), 4%.

<sup>o</sup>Treatments for the control of onion thrips should be started early. In other words, more benefit is gained from early treatments than from later ones especially when considerable damage has already been done by the thrips at the time of the later treatments. †The treatments for this insect usually are delayed too long. The aphids feeding on the young pods cause small misshapen pods containing small hard peas. It is difficult to control aphids hidden in the clam shell. Special attention should be paid to this condition, especially on sweets.

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INSECTS:	When to Control	SPRAYS (Amounts to 100 gal. of water)	DUSTS (Percent strength)
Pea aphid*	(continued from preced- ing page)	TEPP (13), 1 pint of the 50% liquid con- centrate. Please read the instructions on how	TEPP (13), 1%. to apply TEPP safely (13).
		Rotenone (16), 3 lb. of 5% or 3% lb. of 4% concentrate.	Rotenone (16) %% plus 1 or 2% paraffin base oil as SAE-10.
Реа мотн†	Fall and varieties.	Destroy all crop remains. Plow pea stubble in ing before mid-July.	n the fall. Use early varieties matur-
Pea weevil‡	When weevils appear at blossom time.	Rotenone (16), 3 lb. of 5% or 3% lb. of 4% concentrate. Repeat as for dusts.	Rotenone (16) %%. Repeat at 5- day intervals as needed.
DISEASES		CONTROL PRO	GRAM
DAMPING-OFF (soil fungi):		3-year rotation (52).	
ASCOCHYTA BLIGHT (fungus): Causes small dark spots on leaves and pods. Does most damage to roots and stem at ground line. Plants eventually dry up and die. FUSARIUM WILTS (soil-borne fungi): Wilting and		Treat seed with 2 ounces of captan (75), 5 ounces of thiram per 100 lb. of seed (60, 9 Grow resistant varieties from seed produced in	B ounces of Phygon XL (81), or 8 69, 74). n dry-land areas of the west§.
death of plants sometimes without visible symp-			

# PEAS (continued)

# POTATOES

INSECTS:	When to Control	SPRAYS (Amounts to 100 gal. of water)	DUSTS (Percent strength)
Potato aphid¶	When it appears.	Nicotine sulphate (12), 1% pints plus 4 lb. of laundry soap.	Nicotine-lime (12), 4%.

The treatments for this insect are usually delayed too long. The aphids feeding on the young pods cause small misshapen pods containing small hard peas. It is difficult to control aphids hidden in the clam shell. Special attention should be paid to this condition, especially on sweets.
This insect is not important on garden or canning peas in Michigan.
The aseed infested with this insect should not be planted.
A list of peas resistant to wilt is available at all county agents' offices.
This insect builds up rapidly once it gets started. Treatments should not be delayed if there is indication of rapid increase in numbers.

POTATOES (continued)

INSECTS:	When to Control	SPRAYS (Amounts to 100 gal. of water)	DUSTS (Percent strength)
Potato aphid	(continued from preced- ing page)	Parathion <sup>•</sup> (13), ½ lb. of 15% wettable powder where no lime is used. 1 lb. where lime is used.	Parathion <sup>o</sup> (13), 1%.
		Malathion <sup>°</sup> (25), 2½ lb. of 25% wettable powder or 1 pint 50% emulsion.	Malathion* (25), 4%.
		Rotenone <sup>e</sup> (16), 3 lb. of 5% or 3% lb. of 4% concentrate.	Rotenone* (16), ¾%.
	When it appears.	DDT: (9), 1½ lb. of 50% wettable powder or 1 qt. of 25% emulsion.	DDT‡ (9), 3 or 5%.
Colorado potato		Calcium arsenate (1), 4 lb. plus 8-6-100 Bordeaux.	Calcium arsenate (1), 5%.
DEFILE		Pyrethrum <sup>*</sup> (15), ½ pint of a 1% pyrethrins liquid or at manufacturer's directions.	Pyrethrum <sup>•</sup> (15), dusts contain- ing not less than 0.15% pyre- thrins.
Flea beetles†	As soon as beetles appear on the leaves or when	DDT ( $\dagger$ and $\ddagger$ ) (9), 2 lb. of 50% wettable powder or 1 qt. of 25% emulsion	DDT († and ‡) (9), 5%.
	first shot holes appear.	Rotenone <sup>•</sup> (16), 3 lb. of $5\%$ or $3\%$ lb. of $4\%$ concentrate plus a wetting agent (16).	Rotenone* (16), ¾%.
	First treatment should be not later than hay-cut-	DDT $\ddagger$ (9), 1½ lb. of 50% wettable powder or 1 qt. of 25% emulsion.	DDT‡ (9), 3%.
Leafhoppers <sup>†</sup>	ting time. For best con- trol start when hoppers appear. Repeat every 7-10 days as necessary.	Pyrethrum <sup>°</sup> (15), ½ pint of a 1% pyrethrins liquid or at manufacturer's directions.	Pyrethrum <sup>*</sup> (15), not less than 0.1% pyrethrins.
~ .	When they increase in numbers and are not	Toxaphene (19), 1½ actual pounds to the acre.	Toxaphene (19), 7½%. Approxi- mately 30 lb. of dust to the acre.
GRASSHOPPERS§ (in potato fields)	affected by the regular spray schedule.	Parathion <sup>°</sup> (13), 1 lb. of the 15% wettable powder. Please read the instructions on how to	Parathion <sup>°</sup> (13), 1%.

•For best results, parathion, malathion, rotenone and pyrethrum should not be used in combination with bordeaux. Bordeaux destroys their effectiveness. †As indicated, DDT controls flea beetles, Colorado potato beetle and potato leafhoppers on potatoes. CAUTION: Continuous use of DDT in the fall tends to keep potato plants green. Hence, maturity may be delayed.

DDT application must be thorough and on time to control this insect satisfactorily. Two pounds of 50% wettable DDT should be used only when flea beetles are heavy in numbers. Otherwise, use the amount as given for leafhoppers, Grasshoppers as a usual thing do not originate in potato fields, but in grass areas.

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INSECTS:	When to Control	SPRAYS (Amounts to 100 gal. of water)	DUSTS (Percent strength)
GRASSHOPPERS (in margins of potato fields)	When they are present or are migrating into the margins of the fields.	The regular DDT (9) treatment used to treat potato fields can be spray <i>REGULARLY</i> on the margins of the fields. This will tend to cut down on t numbers of grasshoppers in these areas. However, if the DDT treatment do not control the grasshoppers satisfactorily, use the materials listed under "Gra hoppers in Potato Fields."	
WIREWORMS (* and †)	Before potatoes are planted. Apply aldrin, or fertilizers containing it, evenly to the soil surface and disk it to a derth of 2 or 4	Aldrin (21), 8 to 12 lb. of 25% wettable mineral soils; 12 lb. for muck soils. Aldri control. It should be used only on a small about it.	powder to the acre. Use 8 lb. for in is a new chemical for wireworn part of the crop until more is known
	in to a depth of 5 of 4 inches. Do not use chlordane, lindane, or benzene hexachloride for control of wire- worms where potatoes are grown.	Wireworms can be controlled in small gard dibromide (10). These materials are exp generally used on large fields. For amounts facturer's directions on the label.	en plots with DD (7) or ethylend ensive and for this reason are no s to use on small plots, follow manu
WHITE GRUBS (* and †)	Before potatoes are planted.	Plow sod in August. Don't plant potatoes in sod until 2 growing seas breaking. (Read directions on wireworm control above, and see you Agricultural Agent for further instructions.)	
DISEASES		CONTROL PRO	GRAM
<ul> <li>SCAB (fungus): Tuber surface lesions ranging from raised, corky scabs to pits ½-inch deep.</li> <li>EARLY BLIGHT (Alternaria): Dark, irregular spots on leaves and stems. Leaves usually become yellow around many of the spots.</li> <li>LATE BLIGHT (Phytophthora): Dark scalded appearing spots on leaves having a white downy growth on underside during damp weather. Tubers dry rot especially during storage.</li> </ul>		Soil and tuber treatments have not consistent soil as well as the alfalfa-rye rotation <sup>‡</sup> . 4-year rotation (52). Plant certified seed.	y controlled scab in heavily infested
		Cut seed by "dribble-knife method" (59 and Spray at 10-day intervals from time plants are copper as 8-4-100 Bordeaux (63 and 79) of Nabam and zineb (69-73) are also effective	66). 6 inches high with 2 lbs. metallic or as fixed copper (64, 77, and 78) e§.

### POTATOES (continued)

\*Benzene hexachloride should not be used for control of wireworms or white grubs when potatoes or root crops are to be planted within at least the next five years. Lindane should not be used closer than 3 years; in some cases this may not be long enough. †It is not known how long chlordane will remain in the soil compared to benzene hexachloride. However, present research work indicates that at least

3 years should be allowed before planting root crops. This statement is only tentative and may have to be revised as soon as additional information is available.

<sup>‡</sup>Wheeler, E. J., "Residual Effect of Crop Rotations on Potato Yield and the presence of Potato Scab." M.S.C. Quarterly Bulletin v. 28, No. 4, 1946. <sup>§</sup>Nabam or zineb (69, 72 and 73) are effective in controlling late blight and other leaf diseases of potatoes. Use according to manufacturer's directions.

POTATOES (continued)

DISEASES	CONTROL PROGRAM
Whit (caused by Verticillium, Fusarium, or by ring rot bacteria): Wilting and yellowing of plants during growing season sometimes followed by brown discoloration and break-down of vascular tissues of tubers.	- OR - (for LATE BLIGHT) Dust once a week with fixed coppers (64) or with zineb <sup>*</sup> at concentrations recom- mended by the manufacturers (80).
	To reduce tuber infection by spores of the late blight fungus during harvest, kill vines with a chemical weed killer <sup>+</sup> or spray vines and ground surface thoroughly with Bordeaux immediately before digging.
yellow and green mottling, and distortion of leaves. Tubers discolored internally and distorted by some viruses. Viruses are spread in field by in- sects and transmitted from year to year by tubers.	Control leafhoppers and aphids as given to prevent virus diseases.

# TOMATOES, EGG PLANT AND PEPPER

INSECTS:	When to Control	SPRAYS (Amounts to 100 gal. of water)	DUSTS (Percent strength)
APHIDS	When they first appear, or when 6 or more oc- cur on single branches of the tomato plant.	<ul> <li>TEPP‡ (13), 1 pint of the 50% liquid concentrate.</li> <li>Please read the instructions on how</li> <li>Malathion (25), 2 lb. of 25% wettable powder or 1 pint of 50% emulsion.</li> <li>Don't apply malathion closer than</li> <li>Rotenone (16), 3 lb. of 5% or 3% lb. of 4% concentrate.</li> </ul>	<ul> <li>TEPP† (13), 1%.</li> <li>to use TEPP Safely (13).</li> <li>Malathion (25), 4%. 30 lb. to the acre.</li> <li>10 days before harvest.</li> <li>Rotenone (16), ¾% plus 1 or 2% paraffin base oil as SAE-10 lubricating oil.</li> </ul>
Communities	In the spring when the	Nicotine sulfate (12), 1 pint plus 4 lb. of laundry soap.	Nicotine, 4%.
CUTWORMSS	plants are set out.	Poison bran bait (3).	
FLEA BEETLES	When plants are small and before transplanted.	Methoxychlor (11), 2 lb. of 50% wettable powder.	Methoxychlor (11), 5%.

•Nabam or zineb (69, 73 and 74) are effective in controlling late blight and other leaf diseases of potatoes. Use according to manufacturer's directions. +See Circular Bulletin 214 of Michigan State College on Chemical Weed Control at county agent office to select chemical. +TEPP may injure some varieties of tomatoes, especially if the temperature is high. \*The important thing to remember about cutworm control is that these insects feed at night and hide in the soil and rubbish during the day. Baits, sprays or dusts should be applied in the evening, not in the morning. DDT treatments should be applied between the plants near the stalks.

IOMATOES, EGG PLANT AND PEPPER (continued	COES, EGG PLANT ANI	<b>D</b> PEPPER (continued)
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INSECTS:	When to Control	SPRAYS (Amounts to 100 gal. of water)	DUSTS (Percent strength)	
FLEA BEETLES	When insects are trouble- some in the field up to mid-August. One treat-	Methoxychlor (11), 2 lb. of 50% wettable powder.	Methoxychlor (11), 5%.	
(continued)	ment only for DDT.	DDT (9), 1½ lb. of 50% wettable powder. DDT should be used sparingly on tomatoes. the plants. Methoxychlor is safer.	DDT (9), 5%. Too many applications may injure	
	When the beetles are troublesome in the field.	Rotenone (* and †) (16), 3 lb. of 5% or 3% lb. of 4% concentrate.	Rotenone (* and †) (16), %%.	
Tomato fruit worm	Usually when the toma- toes begin to size.	DDD (8), 2 lb. of 50% wettable powder. This material is also used for	DDD (8), 5%. hornworm control.	
Tomato hornworm*	When the first larvae ap- pear. For small acreage:	In small gardens perhaps the best method of early in the morning.	control is to hand pick the worms	
	For large acreage:	DDD (8), 2 lb. of 50% wettable powder.	DDD (8), 5%.	
			Calcium arsenate (1), 10% or 20% depending on how abun- dant and how large the worms are.	
TOMATO RUSSET MITE: This mite is found at present only in Mon-	Apply first treatment mid- July. Waiting until fruit	TEPP (13), 1 pint of 50% liquid concen- trate. Please read the instructions on how	TEPP (13), 1%.	
roe county and on southern grown plants.	poor control practice.	Malathion (25), 1½ lb. of 25% wettable powder. Don't apply Malathion closer than	Malathion (25), 4%. 30 lb. to the acre. 15 days before harvest.	
DISEASES		CONTROL PROGRAM		
DAMPING-OFF (soil fungi): See Beans.		2 to 3-year rotation (52). Treat plant bed soil (51, 53-56, 68, 76).		
EARLY BLICHT (Alternaria): Girdles stems of tomato transplants and defoliates plants later in season.		Immerse seed in water at 122°F. for 25 minutes (57). After drying seed, dust with 4 ounces of thiram (69 and 74) per 100 pounds of seed; or plant certified seed (82). Omit hot water treatment on pepper seed.		

<sup>e</sup>DDD (8) or Calcium arsenate (1) should not be used within 30 days of harvest or where it may cause a residue problem on canning or fresh market tomatoes. It has been the practice of most growers to control tomato hornworm when the worms have advanced to a large size and when damage is noticeable in the field. The satisfactory use of DDD requires that treatments be applied when the worms are small in order to avoid unnecessary residues at harvest time. *Canners should be consulted for permission before using any poison on tomatoes or any other canning crop.* †Rotenone can be used at any time on tomatoes without too much danger of poisonous residues.

### TOMATOES, EGG PLANT AND PEPPER (continued)

DISEASES	CONTROL PROGRAM		
SEPTORIA LEAF SPOT (fungus): Defoliates tomatoes when small circular spots on the leaves become numerous.	Spray plants once a week in seed bed with 2 pounds metallic copper per 100 gallons water (64, 77 and 78).		
LATE BLIGHT (Phytophthora): Causes dark, blue- grey lesions on leaves with white, moldy growth on under-side of leaves. Fruits rot in all stages of growth.	After setting plants in field, spray as soon as first fruit is set with 2 pounds metal- lic copper <sup>o</sup> (64, 77 and 78) per 100 gallons water at 1-week to 10-day inter- used or with sizem papers of sizetions.		
ANTHRACNOSE (Collectrichum): Circular sunken spots on ripe fruit seldom larger than a dime.	(69, 72 and 73).		
FUSARIUM WILT (soil-borne): Fusarium wilt causes yellowing of plants. Vascular elements of stem are discolored, brown.	- OR - Start dusting as soon as the first fruit is set and continue once a week with fixed coppers or with one of the dithiocarbamates indicated as sprays (80). The		
BACTERIAL CANKER: Caused by seed- and soil-borne bacteria. Rotting of internal portion of the stems frequently kills plants. Fruit sometimes covered with small black spots.	Grow varieties resistant to Fusarium wilt such as Rutgers, Marglobe, Pan America, etc. Early varieties are more susceptible to wilt caused by soil-borne fungi.		
Рноморзія Blicht (fungus): Attacks only egg plant causing damping-off and roughly circular grey spots on all above ground parts of the plant. Fruits turn black and shrivel.			

# TURNIPS, RADISHES AND RUTABAGAS

INSECTS:	When to Control	SPRAYS (Amounts to 100 gal. of water)	DUSTS (Percent strength)
Flea beetles	When they appear. Repeat as necessary.	DDT (9), 2 lb. of 50% wettable powder. Rotenone (16), 3 lb. of 5% or 3% lb. of 4% concentrate.	DDT (9), 5%. Rotenone (16), %%.

•Do not use Bordeaux in sprays with TEPP or rotenone. Bordeaux destroys the effectiveness of these materials. †Ziram does not control late blight. It is most effective for control of anthracnose but should be discontinued in favor of the other materials indicated above as soon as late blight is reported in the area.

INSECTS:	When to Control	SPRAYS (Amounts to 100 gal. of water)	DUSTS (Percent strength)
Maggots§	When leaves appear. Re- peat at 7-day intervals if necessary.	Calomel* (4), 1 ounce to 8 gallons of water.	Calomel* (4), 5% plus 95% talc.
		Corrosive sublimate <sup>+</sup> (5), 1 ounce to 10 gal- lons of water.	Dusts of corrosive sublimate are not used.
	NOTE: Rotenone should be used only to prevent infestation, not to get rid of it after the mag- gots are in the radishes.	Rotenone‡ (16), 3 lb. of 5% or 3% lb. of 4% concentrate. Repeat every 4 days for 6 or 7 treatments.	Rotenone‡ (16), ¾ or 1%. Repeat every 4 days for 6 or 7 treat- ments.
For MAGGOTS on turnips only.	Soil treatment before planting.	Heptachlor (24), 16 lb. of 25% wettable powder applied to surface of soil a work into top 2 or 3 inches before planting.	
	Treat as soon as they are up.	Treat with 4 lb. of $25\%$ wettable heptachlor (24) powder in 100 gallons of wat applied to an acre. This treatment is applied on the soil around the small plar as soon as they appear. A second treatment should be applied 21 days aft the first one.	
DISEASES		CONTROL PRO	GRAM
CLUBROOT (fungus): Roots and plant affected same as cabbage.		Do not plant on land where club root of cabl (70).	page and related plants has occurred

## TURNIPS, RADISHES AND RUTABAGAS (continued)

•Calomel is not so dangerous to use as is corrosive sublimate. Wash radishes or turnips thoroughly before using. \*Corrosive sublimate is very dangerous to use. Wash radishes or turnips thoroughly before using or selling. \*Retenone is not so effective as the mercury materials but is safe from poisonous residues. It is necessary to repeat with this material immediately after a heavy rain.

\$Insecticides for the control of maggots are applied on the ground and as close as possible to the plant stems.

## APPENDIX

Again it should be emphasized that the information in this appendix is included to be used; it is not merely material of secondary importance, or of a narrowly specialized nature. It has been broken down into specific sections, according to a definite plan which should be noted. (This will answer any question as to why a gap exists in the consecutive numbering.) That is, any section within the group numbered 1 to 50, inclusive, is concerned with Insect Control measures. Any section numbered 51 and up, with Disease Control. The plan is intended to simplify the addition of other sections in each group, as they become needed in the periodic revision of this bulletin.

Insecticides are discussed first, then the fungicides. Wherever these sections are referred to by number in the tables, they should be read as part of the recommended controls for insects or diseases.

In particular, the special section on the precautions necessary while using parathion and similar phosphate insecticides should be studied very carefully.

#### INSECTICIDES

#### (Sections numbered less than 50 concern Insect Control only.)

1. CALCIUM ARSENATE is a stomach poison. It will not kill sucking insects like aphids, leafhoppers or squash bugs. Calcium arsenate tends to damage plants more easily than does lead arsenate. It should not be used on vegetables so as to leave a poisonous residue at harvest. This material will poison children and livestock if left around carelessly. Rotenone is preferred to calcium arsenate for control of squash vine borer, when safety to the plant is important. (Read also information given for lead arsenate.)

2. LEAD ARSENATE is a stomach poison. It will not kill insects with sucking mouth parts, like aphids and leafhoppers. Lead arsenate should not be used where it will be present as a poisonous residue at the harvest of any vegetable intended for food for livestock or man. For example: It is unwise to use lead arsenate on cabbage for worms later than when the head starts to form. Lead arsenate should not be left around where children and livestock can be poisoned by it. (Read also the information given for calcium arsenate.)

3. POISON BAITS. The insecticides used in baits are *POISONOUS*. They should not be left around where children and livestock can be poisoned by them. Baits for controlling cutworms and grasshoppers are made from the materials given in the following table.

BAIT NO. 1		BAIT NO. 2		BAIT NO. 3	
Sodium fluosilicate*	6 lb.	Chlordane‡	½ actual pound	Toxaphene†	1 actual pound
Bran	25 lb.‡	Bran	25 lb.‡	Bran	25 lb.‡
Sawdust	75 lb.§	Sawdust	75 lb.§	Sawdust	75 lb.§
Water	5 - 7½ gal.¶	Water	5 - 7½ gal.¶	Water	5 - 7½ gal.¶

#### INSECT AND DISEASE CONTROL ON VEGETABLES

\*Paris green may be substituted for sodium fluosilicate. Use 4 lb.

 $^{\dagger}\mathrm{Chlordane}$  or to xaphene can be bought either as concentrated emulsions, or as wettable powders, for making baits.

25 lb. of bran, or 1 part by volume.

§75 lb. of sawdust, or 3 parts by volume.

This may not be the exact amount of water needed. Both bran and sawdust may contain different amounts of water at different times. That will alter the amount of water needed to make a finished bait. Add just enough water to the bran to make it ball, but not stick together. A good test is to place the moistened bait in the hand, and squeeze. Some little moisture should come out between the fingers; however, not too much.

These baits should be applied in the evening for cutworm control, not in the morning. On the other hand, for grasshoppers, put the baits on in the morning as the grasshoppers become active. Scatter between 10 and 20 pounds of wet bait to an acre. (It is usually advisable to double that amount for cutworms.) The bait should be scattered thinly, so as not to poison livestock.

PLEASE NOTE: The hands should not come in contact with the poisons used in grasshopper or cutworm baits. The danger is greatest while mixing or scattering them. When there is any chance of bare hands coming in contact with these poisons, *use rubber gloves*.

#### MIX THE BAITS AS FOLLOWS:

- BAIT No. 1: Mix the sodium fluosilicate, bran, and sawdust together; then add water.
- BAIT No. 2: Mix the sawdust and bran together. Put the chlordane into the water before using the water to moisten the bait. Stir the chlordane-water mixture well.
- BAIT No. 3: Mix the sawdust and bran together. Put the toxaphene into the water before using the water to moisten the bait. Stir the toxaphene-water mixture well.

4. CALOMEL is a mercury compound, but is less poisonous than corrosive sublimate. For this reason, calomel can be used with greater safety. Calomel is insoluble in water; it can be mixed in metal as well as glass or wooden containers. Corrosive sublimate and calomel are used for the same purpose. Of the two, corrosive sublimate is the better insecticide. However, because calomel is less dangerous to use, it is the more desirable material for the average home gardener. For safety, all root crops treated with calomel should be washed thoroughly.

5. CORROSIVE SUBLIMATE is also called bichloride of mercury. It is a mercury compound and is extremely poisonous. *Corrosive sublimate should not be left around where children or animals can be poisoned*. You should not get it into the eyes. Corrosive sublimate must be mixed in glass or wooden containers, *not in metal*. Warming the water will help dissolve this chemical. PLEASE NOTE: All root crops treated with corrosive sublimate should be washed thoroughly (not merely drenched) before using as food.

6. CHLORDANE is an organic chemical insecticide. Like toxaphene it is effective for the control of grasshoppers. Chlordane is also effective for the control of many other insects, but because of residue problems and injury to such crops as cucumbers, squash, etc., it is limited to the control of wireworms on sweet corn, and maggots on cabbage and onions.

The poisonous residues of chlordane are of about the same order as DDT. Hence, it should not be used where there is danger of leaving poisonous residues on plants used for food for man or livestock. Chlordane should not be used on land to be planted to root crops (other than the crops for which it is suggested) within the next three years. The amount of actual chlordane to put on an acre for grass-hopper control is 1 pound when using a spray; 1½ pounds when applying a dust.

7. DD is a soil fumigant. It is a mixture of 1, 3 dichloropropylene and 1, 2 dichloropropane. It is applied to the soil as a liquid. In the soil, it changes to a gas depending on the temperature. The higher the temperature, the more rapid the change from liquid to gas. Precautions and directions for its use are on the containers in which it is bought.

8. DDD (or TDE as it is also called) is related to DDT. DDD is used in the same way as is DDT and for those insects as indicated in the schedule. DDD is less toxic than DDT. However, it should not be used on any vegetable where it will be present as a poisonous residue at harvest time. For example, DDD should not be put on tomatoes closer than 30 days before harvest. IMPORTANT: Canners should have the right to decide whether or not DDD can be used on canning tomatoes. If so, they should determine how far in advance of harvest the last application can be made with safety.

9. DDT is an organic chemical which is used as a spray or dust for the control of insects. It has one important drawback: it leaves a poisonous residue on foods to be eaten by man and livestock. For example: (a) DDT

#### INSECT AND DISEASE CONTROL ON VEGETABLES

should not be put on beans when the pods are forming; (b) DDT should not be used on beets when the leaves are intended for feed for man or livestock; (corn fodder treated with DDT should not be fed to dairy animals or livestock being finished for slaughter within 60 days.

These examples point out the necessity for using it carefully in order to avoid undue or untolerated residues on food plants. This schedule points out how this material can be used so as to produce quality food without undesirable, poisonous DDT residues. PLEASE NOTE: DDT builds up in the soil. DDT remains in the soil. It should not be used in larger amounts or more often than is necessary.

10. ETHYLENE DIBROMIDE is a soil fumigant. It is a liquid when applied to the soil. In the soil it becomes a gas. Precautions for its use are on the container in which it is bought. Ethylene dibromide is extremely poisonous. Special care should be taken to avoid complications when using it.

11. METHOXYCHLOR is related to DDT. It is used in the same manner as is DDT and for those insects indicated in the schedule. Methoxychlor is less toxic than is DDT. However, it should not be used on any vegetable where it will be present as a poisonous residue at harvest time. For example, methoxychlor should not be put on snap beans bearing pods. On crops as cucumbers, beans, and tomatoes, methoxychlor appears to be safer to use than DDT, or lead or calcium arsenate. However, there is some indication that methoxychlor injures varieties of melon.

12. NICOTINE SULFATE. Nicotine is extracted from various parts of the tobacco plant. Nicotine sulfate in this schedule refers to those materials containing 40 per cent nicotine. Laundry soap, fish-oil soap or some of the newer wetting agents must be added to nicotine sulfate in order for it to kill insects satisfactorily. Aphids should be wet thoroughly with nicotine spray to obtain good control. Dusting also should be done thoroughly.

Nicotine sulfate or any nicotine insecticide is highly poisonous, especially in the concentrated form. Users should be careful when handling concentrates, sprays or dusts. Poisonous residues are left by nicotine insecticides. How long they will last depends entirely on the kind of nicotine spray. However, 5 to 7 days under normal conditions should be long enough for the residues of nicotine sulfate to disappear.

13. PHOSPHATES. This group includes parathion and tetraethyl pyrophosphate (TEPP) and other similar materials belonging to the phosphate group of organic insecticides. They are extremely *dangerous to users* (sprayer or duster operations) at the time they are applied to plants.

PLEASE READ THE APPENDIX ON PARATHION. It tells you also how to use safely other phosphate insecticides.

If PARATHION, TETRAETHYL PYROPHOSPHATE, or any other phosphate insecticide cannot be used according to these directions, *they should not be used at all.* In addition to the dangers encountered in their use, phosphate insecticides may also injure plants – especially if used in too large amounts. Parathion injures squash, cucumbers, and muskmelons. Use all of the phosphate insecticides according to directions. Parathion should not be used on any crop closer than 21 days before harvest.

14. PIPERONYL CYCLONENE is a synthetic organic chemical. It improves the insecticidal value of both rotenone and pyrethrum. It can be used with either pyrethrum or rotenone alone or with these materials in combination. When piperonyl cyclonene is used with pyrethrum and rotenone in combination or alone, it does not change materially the relatively non-poisonous nature of these insecticides. It is necessary to use piperonyl cyclonene-combined insecticides as carefully as would be the case with either pyrethrum or rotenone, if they are to be effective.

In most cases it is possible to use piperonyl cyclonene-pyrethrum or rotenone-combined insecticides wherever pyrethrum or rotenone is suggested for use in the schedule. (See the sections on pyrethrum and rotenone for further information.) Other materials are available to use with pyrethrum or rotenone. They should be chosen for use on the basis of effectiveness, safety and freedom from poisonous hazards.

15. PYRETHRUM is made from the flower-heads of several species of chrysanthemums. This insecticide is almost free of poisonous residue problems. For example, it is safe to use at any time on snap beans. The extracts should be used according to manufacturer's directions because it is possible to vary the strength of the liquid concentrates a great deal. The active ingredients of pyrethrum insecticides are called pyrethrins.

16. ROTENONE is an insecticide made from the roots of pod-bearing leguminous plants. The strength of the powder used to make sprays, dusts or extracts may vary quite a bit. The amounts of rotenone in dusts and extracts are standardized at the time of manufacture. The powders used for suspension sprays are normally sold at 4 or 5 per cent concentrate. These are the percentages used in this schedule. PLEASE NOTE: "Suspension sprays" are those insecticides made by putting powders into water.

Rotenone is fairly free from the dangers of poisonous residues. This is because it deteriorates rapidly and after a few days loses much of its insecticidal strength.

Temperatures should be 65° Fahrenheit or better when rotenone is applied. Rotenone should not be used when temperatures are dropping rapidly below 65° Fahrenheit. In other words, it should be applied when temperatures are rising and not falling. PLEASE NOTE: 65° Fahrenheit is the lower temperature range at which rotenone should be used. It is much better for the temperature to be 70, 75 or 80 degrees Fahrenheit, etc. when it is applied. Too high temperatures may affect rotenone as adversely as too low temperatures.

It is necessary to use a wetting agent with rotenone when it is used in water as a suspension. (A suspension is a powder that does not dissolve when it is put into water.) The powder is kept scattered through the water by agitation and wetting agents. Just how much wetting agent should be used to 100 gallons of water can only be determined by the user. However, certain guides can be given for the use of these materials. When too little wetting agent is used, foaming does not occur on the water. When too much has been used, excessive foaming results.

A fair guide to the wetting agent problem is to use the amount of material suggested for use on the label of the bottle in which it is bought. Some commercial wetting agents take as little as 2 ounces to 100 gallons of water. Others may take more. Wetting agents used with rotenone should be neutral in nature. Alkali wetting agents should never be used with rotenone because they destroy the insecticidal value of this material.

17. RYANIA is made from the wood of a tropical plant. It can be used on corn for the control of corn borer without concern over a poisonous residue. In other words, the fodder of corn treated with ryania can be fed to livestock. The main drawback to ryania is its high cost compared with DDT.

18. SABADILLA is made from the seeds of one of the lily plants. In this schedule, it is suggested only for the control of the squash bug. The dust form is used. It may be necessary to apply it more than once to get satisfactory control of the bugs. Best results are had when it is dusted directly on the insects. Users may find this insecticide irritating.

19. TOXAPHENE is an organic chemical insecticide. Effective for the control of grasshoppers and cutworms, it is suggested in this schedule for these purposes only. Toxaphene cannot be used on cucumbers for cutworm control. It severely injures these plants.

Toxaphene is said to be about 4 times as toxic as DDT. Less is known of its residues than about those of DDT. Therefore, recommendations for its use will be limited until more is known about it. It should not be used on any crop intended for food for man or animals.

20. CRYOLITE usually causes less injury to plants than other forms of fluorine insecticides. It is a stomach poison. As is the case with lead arsenate, it does not kill sucking insects as aphids or leafhoppers. Cryolite should not be used on vegetables so as to leave poisonous residues at harvest. Thirty days are needed between the last treatment and harvest. 21. LINDANE is a chlorinated hydrocarbon as is DDT. Its poisonous residues are of about the same order as DDT. However, lindane (unlike DDT) has an unfortunate drawback in that it may cause off-flavoring (chemical taste) of vegetables and fruits, especially if they are processed in jars or cans. Because of this characteristic, suggestions for its use in this bulletin are limited to seed treatments for maggots. Lindane should not be used on seed-producing plants. Seed treatments with lindane may or may not be successful for control of wireworms.

Lindane, like all poisonous insecticides, should be stored safely from children and kept away from food products. Seed treated with lindane should not be used for food.

22. DIELDRIN is another chlorinated hydrocarbon. It belongs with such materials as chlordane and DDT. The poisonous residues of dieldrin tend to be more dangerous than either DDT or chlordane. The effectiveness of dieldrin lasts for a considerable length of time and in this respect is much like DDT. Because it has both long-lasting and poisonous residues, avoid planting root crops other than onions for three years where dieldrin has been used.

Dieldrin is showing promise for the control of a number of insects. However, suggestions for its use are being limited in this bulletin to seed and foliage treatments of onions. When using the furrow treatment, spraying or dusting may be needed 30 days after seeding to protect the onions. The reason is twofold: In the first place more than one kind of maggot damages onions—this prolongs the need for protection beyond 30 days. Secondly, the furrow treatment normally does not last longer than 30 days against any maggot infesting onions.

23. ALDRIN is also a chlorinated hydrocarbon. It is closely related to dieldrin. While they last, the residues of aldrin are more dangerous than dieldrin. Aldrin differs from dieldrin in that it does not remain as effective as long. Aldrin like dieldrin is effective as a soil insecticide.

Suggestions for the uses of aldrin in this bulletin are limited to the control of grasshoppers on the margins of asparagus fields, and for soil treatment of wireworms damaging sweet corn and potatoes. It is extremely important to note the restrictions placed on aldrin for wireworm control in potato fields. This caution is necessary because more time is needed to clearly establish this material as a safe and effective soil insecticide.

Aldrin, generally speaking, is more toxic than many of the insecticides being used today. Because of this, it should be used in such a way as to avoid breathing or getting it on the skin. If spilled or sprayed on the skin, wash off immediately with soap and water. Aldrin should be stored carefully to prevent children getting into it. Contamination of food products should be avoided. Avoid planting root crops other than potatoes for three years where aldrin has been used.

24. HEPTACHLOR: This insecticide is a chlorinated hydrocarbon. In some respects it is similar to aldrin, dieldrin, and chlordane. It is very close to dieldrin in poisoning characteristics. Heptachlor should not be used on plants intended for food for man and livestock. It should be stored carefully so children cannot come in contact with it. Avoid getting heptachlor on the skin or breathing it.

Heptachlor is a relatively new material. More needs to be known about it. Therefore, suggestions for its use in this bulletin are being limited to the control of turnip maggots. Avoid planting root crops other than turnips for three years where heptachlor has been used.

25. MALATHION: This material is a phosphate type insecticide belonging to the same general group as parathion and TEPP. It is much less dangerous to use than either parathion or TEPP. *However, you should* follow the instructions on the label for safe use of malathion.

Malathion shows promise for the control of a considerable number of insects and mites. However, suggestions for its use are limited in this bulletin to the control of tomato russet mite, Mexican bean beetle, potato and tomato aphids. Malathion should not be applied to tomatoes or other crops closer than 10 days before harvest. Canners using malathion on snap beans and tomatoes should make sure that it is safe from the standpoints of residue and off-flavoring. Use with caution on tomatoes and beans; malathion may injure these plants.

#### PRECAUTIONS FOR THE USE OF PARATHION

(These same instructions apply to the use of Tetraethyl Pyrophosphate or "TEPP", and other Phosphate insecticides.)

The following instructions for the safe use of PARATHION are found on the label of every package bought. If there are no instructions for the use of this insecticide on the label, return the material and demand parathion with the instructions and precautions printed on the label. If it is impossible for you to use parathion according to the following rules, either you should not purchase it at all or should return without use any you have already bought.

The precautions for the use of parathion are as follows:

FIRST – Avoid breathing wettable powders, dust or fumes while handling parathion. Avoid dusts or sprays while putting them on crops.

SECOND — Suitable masks should be worn at all times when there is any chance of breathing it. Masks can be purchased from insecticide dealers who sell parathion.

THIRD – Suitable goggles should be worn when there is danger of getting parathion in the eyes.

FOURTH – If wettable powder must be handled with the hands use only *natural rubber gloves* – never cloth, leather or synthetic rubber gloves.

FIFTH - If it is impossible to keep out of spray or dust drift, wear protective clothing such as plastic rain coats or cellophane sheets. Wear a plastic or washable rain hat.

SIXTH – Hands, arms and face should be washed before eating or smoking.

SEVENTH – You should stop using parathion and go to a doctor the moment you feel any one or more of the following symptoms:

(a) headache; (b) blurred vision; (c) weakness; (d) nausea; (e) cramps; (f) diarrhea; and (g) discomfort of the chest.

EIGHTH – Notify your doctor, well in advance, that you intend using parathion. Tell him that the antidote for parathion poisoning is ATROPINE. Instructions for the use of atropine by *doctors* can be had from the parathion label on the package purchased, from your county agricultural agent or from Michigan State College, East Lansing. A copy of the information to doctors is printed as a part of these precautions.

#### SPECIAL WARNING

NOTE TO FIELD WORKER: All people should avoid working in fields, vegetables, or orchards for 10 days after parathion has been applied to these places.

NOTE TO AIRPLANE PILOTS: Pilots should know the dangers of applying parathion and other phosphate insecticides before doing so. They should know especially the dangers of skin and respiratory absorption.

#### **INFORMATION ABOUT ATROPINE**<sup>4</sup>

ATROPINE is the emergency antidote for parathion poisoning. Atropine is obtainable only on a doctor's prescription. The doctors in your neighborhood should be informed regarding the symtoms of parathion poisoning and the treatment therefore, as shown below. Consult your doctor and arrange with him for a prescription of atropine grains 1/120(0.5 mg.) to be kept on hand for emergency use. Never take atropine or any similar drug until *after* warning symtoms appear.

<sup>&</sup>lt;sup>4</sup>These sections on "Information About Atropine" and "Note to Physicians" are reprinted by permission from literature issued by the American Cyanamid Company, New York 20, N. Y., manufacturers of parathion.

#### INSECT AND DISEASE CONTROL ON VEGETABLES

The symptoms of parathion poisoning include headache, blurred vision, weakness, nausea, cramps, diarrhea, and discomfort of the chest. If you feel any of these symptoms while spraying with parathion, quit spraying, take two atropine tablets at once, and go to a doctor. Do not spray again with parathion or other organic phosphate insecticides until your doctor has examined a blood sample for parathion effect. When you go back to the job, be sure you observe all the precautions outlined above.

#### NOTE TO PHYSICIANS

Parathion inactivates the cholinesterase enzymes of the blood and tissues and, therefore, the signs and symptoms resulting from excessive absorption are primarily those of marked parasympathetic stimulation. Hyperhidrosis, miosis, lachrymation and salivation may be noted in addition to signs and symptoms noted above. If the patient has already taken atropine, as indicated above, the physician should administer additional doses of grains 1/60 to 1/30 (one or two mg.) of atropine every hour — up to ten or twenty mg. in a day if necessary — to control the respiratory symptoms and keep the patient *fully* atropinized. The intravenous route is the most rapid. It will be noted that the dosage of atropine here is in excess of amounts conventionally employed, but within safe limits. For mild poisoning this treatment alone is sufficient.

DO NOT GIVE MORPHINE. If pulmonary secretions have accumulated before atropine has become effective, the patient must be turned upside down to cough out mucus. The parasympathetic effect on the heart and lungs is blocked by atropine. Weakness and muscular twitching are not controlled by this antidote. Even with very serious poisoning, atropine can completely protect the airway, but muscular weakness may become so excessive that artificial respiration is required.

Insert a tracheal tube. Suck mucus from bronchi with a catheter. Empty distended stomach with Levine tube. Complete recovery may be expected even after a very severe acute poisoning and many hours of artificial respiration. Administration of oxygen is indicated, provided that adequate attention to the airway has been given. The acute emergency lasts 24 to 48 hours; patient must be watched continuously during this interval.

Following exposure heavy enough to produce symptoms, further organic phosphate insecticide exposure should be avoided. The patient remains susceptible to relatively small exposures of parathion until regeneration of blood and tissue cholinesterase is nearly complete. Other organic phosphate insecticides also inactivate cholinesterase. Persons exposed to these become susceptible to parathion and vice versa.

#### FUNGICIDES

#### (Sections of the Appendix number 51 and up concern Disease Control measures only.)

51. DAMPING-OFF is caused by seed-borne and soil-borne fungi. It is most destructive when air temperatures are extreme, when humidity is high, and when soil moisture is excessive. Control of damping-off will result if the conditions which favor its development are avoided, and if the fungi are eliminated from the seed and soil as much as possible.

The following include some of the routine practices which will tend to check the development of damping-off. Ventilate the plants as much as possible by frequent adjustment of vents. Thin seeding in rows instead of broadcasting will permit maximum aeration of each plant. Avoid excessive moisture in the soil. Wet soil favors the growth of the fungi, and also results in succulent plants which are more susceptible to infection.

52. ROTATION OF CROPS: Crop rotation aids control of many soil-inhabiting organisms that cause plant diseases. It is the most important method of getting satisfactory control of some of them. Usually a 3-year interval between plantings of a vegetable on the same soil is sufficient. Micro-biological activity associated with roots of intervening crops tends to eliminate the particular organisms that cause diseases of the vegetable in question. Sometimes it is necessary to wait 7 or 8 years as in the case of club root of cabbage. IMPORTANT: The fungus causing potato scab persists so well in some soils that rotation is not effective.

53. STEAM TREATMENT OF SOIL: Soil treatment by either heat or chemicals is not intended to kill all micro-organisms, but only to check the particular fungi which cause disease. Most of the micro-organisms in the soil are beneficial to the nutrition and growth of plants. Steaming soil controls all plant pathogens, and should be used wherever equipment permits.

Bury 3-inch clay tile in rows 12 to 16 inches deep and 18 inches apart, as for drainage. Cover each joint with a shovel full of crushed rock or fine stones. Introduce steam at 20 to 80 pounds pressure into the tiles through "headers", keeping the soil covered with sacks or heavy paper.

The higher pressures will require less time to steam the soil, but they should not exceed the limit indicated because of the danger of releasing excess soluble salts and breaking down the structure of the soil. A 50 pound boiler will steam about 500 square feet of a bed satisfactorily. Turn the steam off when the soil reaches 160 degrees Fahrenheit. If the soil is infested with Fusarium wilt fungi, turn steam off at 180 degrees Fahrenheit.

54. FORMALDEHYDE TREATMENT OF SOIL: For treating soil in benches or stationary beds, use a solution of 1 part of formaldehyde

to 30 parts water. Work the soil and sprinkle about 3 gallons of the formaldehyde solution on each 10 square feet of bed surface. Cover soil for 24 hours, remove cover and work soil to aid escape of fumes. Rework again in 1 week and plant at end of 14 days.

For small amounts of soil spread to a depth of an inch or two on a hard surface. Put 1 pint of formaldehyde and 1 pint of water in a quart jar atomizer. Atomize the surface of the soil with the solution and shovel it into a pile. One quart is adequate for 50 flats of soil. For best results cover the pile for 24 hours immediately after treatment. It is safe to plant immediately. If compost is mixed in a concrete mixer, the solution may be sprayed directly into the mixer as the soil is going through. Use a nozzle that delivers about 1 quart of the solution for each 10 bushels of compost.

55. CHEMICAL SOIL FUMIGATION: Trichloronitromethane (chloropicrin) and methyl bromide are the effective fungicides of the available soil fumigants. They should be used at increased dosages of 8 milliliters and 50 milliliters, respectively, on 10-inch centers. These fumigants control damping-off fungi – but they will not consistently kill bacterial, Fusarium, and Verticillium wilt organisms, or the sclerotia-forming fungi such as Rhizoctonia. To kill the latter, the soil is treated in small lots that can be held in gas-tight chambers at least 4 hours.

56. SURFACE DRENCHING: Semesan is sometimes effective for checking mild damping-off in seed beds. Wet the soil with a suspension of 1 ounce of Semesan in 3 gallons of water. IMPORTANT: Do not spray vegetables in the seed bed with copper if they have received this Semesan treatment for damping-off.

57. HOT WATER TREATMENT OF SEED: To kill all seed-borne fungi and bacteria by hot water, be sure the temperature of the water and length of time of the treatment are maintained accurately. A few degrees of additional heat may injure the seed. Place seed in a loose-mesh bag about twice the capacity required for the amount of seed being treated. Immerse in 10 to 15 gallons or more of water per pound of seed at the specified temperature. Stir constantly and maintain temperature by frequent additions of small amounts of boiling water. An accurate thermometer should be purchased for this purpose. Compare its accuracy with standard thermometers at local dairys or drug stores.

58. MERCURIC CHLORIDE (Corrosive Sublimate) SOAK TREAT-MENT: Place seed in a cheese cloth or other loose-mesh bag of about twice the capacity required for the amount of seed being treated. Immerse and agitate the seed to be sure all are thoroughly wetted by the solution. After immersion in the solution as directed, remove and rinse thoroughly in running water. 59. MERCURIC CHLORIDE dissolves rapidly in hot water. Dissolve the required amount of chemical in about 2 quarts of hot water, then dilute with cold water. For a 1/1000 concentration, dissolve 1 ounce of mercuric chloride in 8 gallons of water. *Mercuric chloride is a deadly poison* to humans and animals. Dispose of surplus solutions in such a way that they will not be consumed. It also corrodes metal and should be handled in wooden or earthenware containers.

60. DUST TREATMENT OF SEED: Dust-seed-treatment materials should not be used in excess of the amounts indicated in this schedule, or as directed by the manufacturer. If excess amounts are used to treat very small quantities of seed, be sure to sift-off all free dust which does not adhere to the seed surfaces. Shaking the seed and dust together in a closed container for 3 minutes will result in uniform dusting of all the seed. The container should have twice the capacity of the volume of seed to be treated.

61. SLURRY METHOD OF APPLYING SEED TREATMENT MATERIALS: Several fungicides including thiram, Ceresan M, Captan and Phygon XL are adapted to slurry application. First, measure the amount of dust to be applied to a given quantity of seed accurately. The amounts are the same as for dry applications. Overloading can do more harm than good. Second, mix dust with just enough water to make a sloppy paste. An excess of water will prolong drying of the seed. Then stir or swirl the seed in the slurry until the seed surfaces are covered. The fungicides will adhere to the seed better and the irritating effects of dry dusts will be minimized. Commercial equipment is available for treating large quantities of seed by the slurry method.

Treated seeds are available from seed stores and elevators. You may find this a better method of getting treated seed than by doing it yourself.

62. COPPER SULFATE: One of the first chemicals used to control fungi, copper sulfate is non-toxic to humans unless taken internally in quantity. It will injure plant tissue when not mixed with lime.

63. BORDEAUX MIXTURE: This is one of the oldest and most effective fungicides for the control of leaf blights and fruit rots of many vegetables — including celery, potatoes, tomatoes, carrots, etc. The interaction of the copper sulfate and lime in water results in a relatively insoluble, flocculent precipitate of basic copper sulfates. The particles are flaky and so small that they result in a water suspension with the properties of a colloidal suspension. Injury sometimes results on cucurbits and tomatoes when it is used on those crops.

64. FIXED COPPERS: This group of copper compounds includes basic copper sulfates, copper oxychloride, cuprous oxide, and the like.

The materials as purchased are relatively insoluble, and do not require the addition of lime – as does the very soluble copper sulfate used in making bordeaux mixture. Their lower solubility makes them less injurious to vegetables than bordeaux, especially to those that are susceptible to injury from lime as well as from copper – melons, cucumbers and tomatoes.

Fixed coppers have been most effective on tomatoes for controlling early blight, Septoria leaf spot, and late blight. When used in dust form, they are superior to other dust fungicides now available. There is some variability in toxicity to both plants and fungi among the various compounds – depending on solubility and the size of the particles. For this reason it is important that directions of the manufacturer be followed carefully.

65. CERESAN is an organic mercury compound developed originally for seed treatment of vegetables. It is a different chemical than "new improved ceresan" and "ceresan M" used on cereals.

66. CERTAIN SANITATION MEASURES, if followed each year in the handling of potato seed stocks, will prevent trace amounts of bacterial ring rot infection from spreading and causing heavy losses. These sanitation measures include:

(a) The use of the *dribble-knife method* in cutting seed. The term "dribble-knife-method" refers to the use of a stationary knife mounted upright in a convenient position on the cutting table, and with the upper end of the blade attached to a wick leading from a container of solution. The solution is mercuric chloride at a strength of 1 to 500 parts of water by weight.

The flow of mercuric chloride from the containers is adjusted in such a way that there is a constant film of the material running down the wick, and over the surface of the knife, during the entire process of cutting seed pieces on the knife blade.

(b) Spray all crates, planters, diggers, graders and bins with copper sulfate (62). Use a strength of 20 pounds per 100 gallons of water, with 300 to 600 pounds pressure from a single-nozzle orchard gun.

(c) Get new sacks or soak used sacks in formaldehyde -1 pint to 15 gallons of water (76). These measures will help insure against trace amounts of ring rot in seed, which can increase within a year or so to the point where serious losses result.

67. SULFUR: Elemental sulfur has been of little value for the control of vegetable diseases. Research in recent years has indicated that (73 and 80) sulfur mixed with zineb is one of the most effective fungicide mixtures for the control of some diseases on onions and celery.

#### MICHIGAN EXTENSION BULLETIN 312

68. SEMESAN: (Hydroximercurichlorophenol) Semesan in the dry powder is a standard seed treatment for many vegetables.

69. "DITHIOCARBAMATES": The following have been chosen as the common chemical names of some of the organic chemicals used as fungicides. The five words (ferbam, ziram, nabam, zineb, and thiram) are coined common names for specific chemicals. They should be used as common names. When written, the first letter should not be capitalized except where such capitalization is in keeping with the accepted use for common names.

Common Name	Chemical Ingredient	
ferbam ferric dimethyl dithiocarbamate		
ziram	zinc dimethyl dithiocarbamate	
nabam	disodium ethylene bisdithiocarbamate	
zineb	zinc ethylene bisdithiocarbamate	
thiram	tetramethylthiuram disulfide	

The dithiocarbamates are derived from dithiocarbamic acid and are among the first of the non-mercury, organic fungicides to have taken a permanent place in the field. They have made a real contribution on certain copper-sensitive vegetables, and for the control of some diseases.

Compared with copper fungicides, they have, in general, these important characteristics:

(a) They are more "specific" in their toxicity to fungi – that is, they may be more effective in control of one disease but control fewer diseases.

(b) They are less injurious to vegetables.

(c) They lose their toxicity more rapidly on exposure to rain, air, and sunlight.

(d) They do not adhere to plant surfaces as well and must be applied more often.

(e) They clog nozzles less.

(f) They are more irritating to the skin of many people.

70. FERBAM: Ferbam as a spray or dust provides moderate protection against most leaf blights of vegetables, but other dithiocarbamates are usually preferred. Ferbam is widely used in the control of diseases of fruit and ornamental plants.

#### INSECT AND DISEASE CONTROL ON VEGETABLES

71. ZIRAM: Ziram is the most effective spray material available for control of tomato anthracnose. It is also generally effective against other vegetable diseases *except late blight of potatoes and tomatoes*.

72. NABAM: Nabam is generally effective as a vegetable spray including control of late blight and almost eliminates clogging of nozzles. It is mixed with zinc sulfate before using.

73. ZINEB: Zineb is essentially nabam-plus-zinc-sulfate in powdered form. It controls the same diseases as nabam.

74. THIRAM: Thiram is one of the most effective seed treatment materials for many vegetables and turf diseases. In preliminary work it is showing promise as a soil treatment for control of diseases of onions, sugar beets, and possibly of legumes. It is available as a wettable powder called Tersan for control of turf diseases, and as Arason for seed treatment and soil applications.

75. CAPTAN is a complex organic chemical that is finding favor as a fruit spray. It is now available as captan seed protectant.

76. FORMALDEHYDE has long been used to control damping-off fungi in greenhouse soil. It is very irritating to the skin and membranes of the eyes. Handle with care; wash hands and other skin areas exposed to the solution *immediately* after using.

77. CALCULATING the amount of fungicide needed in 100 gallons of spray for the concentrations indicated in the schedule:

Take one of the common fixed copper fungicides – tribasic copper sulfate – the package will indicate that it contains 53% metallic copper. In other words about ½ of each pound is copper, and for a spray mixture containing 2 pounds of metallic copper, 4 pounds of the commercial tribasic copper sulfate will be required. Many of the fungicides are packaged in 2 pound sacks eliminating the need for scales.

Amounts of organic fungicides recommended for 100 gallons of spray refer to the commercial product, and not to the percentage of active ingredient.

78. CALCULATING the amount of fungicide needed in 5 gallons of spray:

Continuing with the above example, convert the 4 pounds required for 100 gallons to ounces  $(4 \times 16 = 64)$ . One gallon will require 64/100or .64 ounces; 5 gallons of spray should contain  $5 \times .64 = 3.20$  – or about 3 ounces of tribasic copper sulfate. The first spray mix will require the use of scales graduated in ounces. Measure the amount in an old tin can and keep it with the fungicide package. Measure out an equal volume each time thereafter.

#### MICHIGAN EXTENSION BULLETIN 312

For a 3-gallon knapsack sprayer, use ½ the amount arrived at by the above process in 2½ gallons of water. Most fungicides vary widely in volume for a given weight. Separate containers should be calibrated for each. Sometimes the organic fungicides vary in volume for a given weight from season to season. Each new batch should be weighed, and the volume adjusted accordingly.

79: PREPARATION OF BORDEAUX MIXTURE: Bordeaux is a colloidal suspension of basic copper sulfates. It results from the chemical reaction between a solution of copper sulfate and a dilute solution of lime. When properly prepared, the particles are uniformly small, individual flakes — which on drying produce a spray residue that adheres to plant surfaces better than the residue of any of the other copper fungicides.

The designation "8-4-100 Bordeaux" means 8 pounds of copper sulfate, 4 pounds of lime, and 100 gallons of water. The powdered and snow forms of copper sulfate are the most efficient commercial products for spray purposes. Chemical hydrate lime or spraying lime is the best suited of the commercial limes for mixing Bordeaux in modern spraying equipment.

To prepare Bordeaux mixture, make the required amount of lime into a thin paste – and stir it into about 2/3 of the total volume of water to be used. Using about one gallon of water for each pound, dissolve the required copper sulfate and stir the solution into the dilute solution of lime water. Continue stirring while adding water to make the desired amount of spray mixture.

For sprayers equipped with agitators, start the agitator when the tank is 2/3 full of water, wash the lime through the strainer and then wash the copper sulfate through and continue adding water until the tank is full.

80. DUST: In general, fungicide dusts must be used more often than sprays to obtain comparable results. In the case of a few diseases – such as downy mildew of onions and leaf blights of celery–dusts have proved to be the more practical. Dusts require special machinery to mix the active ingredient uniformly with the diluent and usually cannot be prepared properly by the user.

81. PHYGON XL: Phygon XL (dichloro naptho-quinone) is an effective seed protectant for vegetables—either by the dust or slurry methods.

82. CERTIFIED TOMATO SEED that has been inspected by the Bureau of Plant Industry, Lansing, Michigan, is free of the bacteria and fungi that causes seed-borne diseases.

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