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Chemical Controls for Michigan Commercial Greenhouse and Bedding Plant Production Michigan State University Extension Service William H. Carlson, Alan Putnam, Horticulture; Frank Laemmlen, Plant Pathology; Darryle Warncke, Crop and Soil Science Issued April 1980 1 pages

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Chemical Controls for Michigan Commercial Greenhouse & Bedding Plant Production

COOPERATIVE EXTENSION SERVICE • MICHIGAN STATE UNIVERSITY • EXTENSION BULLETIN E-1275, April 1980

DISEASE	CHEMICAL	RATE/100	RATE/GAL	RATE/AREA	COMMENT
Damping-off Rhizoctonia	PCNB ¹ (Terraclor 75%)	1/4 lb	11/4 tsp	1/4 lb/100 gal/ 100 sq ft	Preplant application
	BENOMYL	½ lb	1 Tbl	1-2 pt/sq/ft	10-14 di ³
	Banrot	½-½ lb	½-1 tsp	1 pt/sq ft	4-8 wi ⁴
Damping-off	Lesan	½-1 lb	1½-3 tsp	1 pt/sq ft	2-4 wi
Pythium	Truban	4-6 oz	½ tsp	1 gal/8 sq ft	4-8 wi
	Captan ¹	2 lb	8 tsp	4-5 oz/1,000 sq ft	Preplant application
	Banrot	1/4-1/2 lb	½-1 tsp	1 gal/8 sq ft	4-8 wi
Botrytis	Captan	2 lb	8 tsp	X_2	5-7 di
	BENOMYL	½ lb	1 Tbl	X	10-14 di
	Daconil 2787	1½ lb or			
	$(Chlorothalonil)^2$	1½ pt	1½ tsp	X	7-14 di
	Maneb ¹	1-3 lb	1%-5 tsp	X	7-10 di
	Mancozeb ¹	1½-3 lb	1-2 Tbl	X	7 di
	Ferbam ¹	3/4-11/8 qt or	11/3-12/3 tsp or		7 10 T
	Zineb¹	1-1½ lb 1½-2 lb	1-1½ Tbl 1½-2 Tbl	X X	7-10 di 7-10 di
	Copper oxychloride	172-410	172-4 101	$oldsymbol{\Lambda}$	7-10 di
	sulfate	3-4 lb	4-5 tsp	X	7-14 di
	Bordeaux mixture ¹	6 lb CuSO ⁴ +	1 o tsp		
		6 lb Lime	6 Tbl	X	2 wi
	Botran ¹	½-1 lb	1-2 Tbl	X	5-7 di
Fusarium Rot	BENOMYL	1 lb	2 Tbl	1-2 pt of mixture/	
				sq ft	2-4 wi
	Banrot	½-½ lb	½-1 tsp	1 pt/sq ft	4-8 wi
Sclerotinia Rot (White mold)	PCNB ¹ (Terraclor 75%)	⅓ lb	11/4 tsp	1/3 lb/100 gal/: 100 sq ft	Preplant application
	BENOMYL	1 lb	2 Tbl	1-2 pt/sq ft	2-4 wi
	Banrot	1/4-1/2 lb	½-1 tsp	1 pt/sq ft	4-8 wi
	Captan ¹	2 lb	8 tsp	3-4 pt/100 sq ft	7-10 di
Powdery Mildew	BENOMYL	½ lb	1 Tbl	X	10-14 di
	Dinocap	4 oz	1 tsp/4 gal	X	7-10 di
	Actidione PM		5 Tbl	X	7 di
	Sulfur ¹	2 gal	1 pt/6 gal	X	7-10 di
	Folpet ¹	2 lb	2 Tbl	X	7-10 di
Alternaria	Daconil 2787	1½ lb or			
	$(Chlorothalonil)^2$	1½ pt	1½ tsp	X	7-14 di
	Mancozeb ¹	1½-3 lb	1-2 Tbl	X	7 di
	Ferbam ¹	1-1½ lb	1-1½ Tbl	X	7-10 di
	Zineb ¹	1½-2 lb	1½-2 Tbl	X	7-10 di
	Folpet ¹	2 lb	2 Tbl	X	3-7 di
	Ziram¹ Bordeaux mixture¹	2-3 lb 8 lb CuSO ⁴ +	2-2½ Tbl	X	7-10 di
	Dordeaux mixture	8 lb Lime	14 Tbl	X	7-14 di
	Tribasic Copper	o io Dillie	11101	4	1111
	Sulfate ¹	3 lb	3½ tsp	X	10-14 di

Fertilizing

Most growers soil test their original mix and then Remember: There are many fertilizer programs. All add the fertilizers recommended. Superphosphate is often added to the mix and the grower then fertilizes with nitrogen and potassium, as needed, through the

A common recommendation is 200 ppm of N and K at every watering (13 ounces of 20-20-20 per 100 gallons). However, since most growers are interested in short plants, they may reduce the frequency of fertilization. Another method is to use a slow release fertilizer like 14-14-14 at 2 to 4 pounds per cubic yard of soil. This provides enough nutrition for about the first 4-6 weeks. Then the grower finishes off the crop with applications of liquid fertilizer.

TABLE 1. Determining PPM.

Multiply percent of any element in any given fertilizer by 75. This gives ppm in one ounce of fertilizer in 100 gallons of H₂O.

 $Ex. = (NH_4)_2SO_4 = 20\% N$ 20% (.20) X 75 =

15 ppm in 1 oz (NH₄)₂SO₄ in 100 gal H₂O

To determine the number of ounces required to make up a 200 ppm solution, divide $200/15 = 13\frac{1}{3}$ ounces.

 $100 \text{ ppm} = 100/15 = 6\frac{2}{3} \text{ oz}$

TABLE 2. Instructions for Use of Solu-bridge.

- 1. Use tall cylinder for solu-bridge sample (1 part soil: 2 parts distilled water) as mixture must be 1/2 inch above hole on conductivity cell.
- 2. Use thermometer to check temperature of soil sample, and set temperature on solu-bridge compensator knob
- 3. Immerse conductivity cell at least ½ inch above air vents; there must be at least 1/4 inch clearance on sides 4. Move conductivity cell up and down under liquid sur-
- face to remove all air bubbles. 5. Turn solu-bridge on. Move the big circular dial until
- both the red and green lights are on. 6. Read scale around outer rim of dial. This reading (K
- value) is in mmhos. 7. Turn solu-bridge off.
- 8. Rinse conductivity cell off with distilled water never 9. Store cell either in clean distilled water or in dry con-
- K VALUE SCALE IN MMHOS Below .25 — soil deficient

.25 - .50 — low in soluble salts .50 - 1.00 — adequate Above 1.00 — high soluble salts — trouble can produce excellent results if done properly. However, don't overfertilize or underfertilize. Good plants are the result of a good fertilizer program.

TABLE 3. Guidelines for Solu-bridge Readings in

INTERPRETATION ellent — very few salts present.
llent years for salts present
ment — very rew saits present.
ptable.
e crops may have reduced oth, no symptoms.
stionable — few crops tolerant.
essive — normal failure.

Keeping the soil wet will allow the plant to grow better under conditions of higher soluble salts in the soil than if it is kept dry. Drying the soil causes a concentration of the soluble salts in the soil solution. If soluble salts is high, leaching is desirable.

TABLE 4. Materials for Adjusting Soil pH. Limestone required to raise the soil pH one unit.

	SANDY LOAM	LOAM	CLAY LOAM OR PEAT
Lb/100 sq ft	4	8	12
Lb/cu yard	21/2	5	7
Oz/bu	2	4	6
Materials and rates	to decrease	the soil pl	H one unit.
Lb/100 sq ft			
Aluminum sulfate	2.5	5	7
Iron sulfate	2.5	5	7
Sulfur	0.5	1	1.5
Lb/cu yard			
Aluminum sulfate	1.2	2.5	4
Iron sulfate	1.2	2.5	4
Sulfur	0.2	0.5	0.7
Oz/bu			
Aluminum sulfate	1	2	3

Phosphoric acid may be injected into water system to adjust the pH to 6.2. Water sources vary greatly. Each sample must be tested to determine the amount to add.

TABLE 5. Converting Degrees Fahrenheit to Degrees Celsius.

Subtract 32 from the Fahrenheit reading, then multiply by 5/9 (.555) to get the Celsius reading.

TABLE 6. V	arious Soluble Salt	Testing Procedures	and Interpretations.
SATURATED EXTRACT ¹	1 PART SOIL TO 2 PARTS WATER MMHOS	1 PART SOIL TO 5 PARTS WATER	
all soils	mineral soils	organic soils	
074	025	012	Very low salt levels. Indicates very low nutrient status
.75 - 1.99	.2550	.1235	Suitable range for seedlings and salt-sensitive plants.
2.00 - 3.49	.50 - 1.00	.3565	Desirable range for most established plants. Upper range may reduce growth of some sensitive plants.
3.50 - 5.00	1.00 - 1.50	.6590	Slightly higher than desirable. Loss of vigor in upper range Okay for high nutrient-requiring plants.
5.00 - 6.00	1.50 - 2.00	.90 - 1.10	Reduced growth and vigor. Wilting and marginal leaf burn
6.00+	2.00+	1.10+	Severe salt symptoms — wilting. Crop failure.

To convert mmhos to ppm, multiply by 700. ¹ Used by the soil testing lab at Michigan State University.

TABLE 7 Michigan State University Soil Testing Interpretation

General Gui	delines for Gree	enhouse Soil Test Nut	trient Levels and T	heir Interpretation	
SOIL TEST	LOW	ACCEPTABLE	OPTIMUM	HIGH	VERY HIGH
pH	< 5.5	5.5 - 7.0	6.0 - 6.4	7.0	> 7.5
Soluble Salts mmhos	074	.75 - 1.99	2.00 - 3.49	3.5 - 5.00	5.00+
Nitrate-N ppm	0 - 39	40 - 99	100 - 179	180 - 280	280+
Phosphorus ppm	0 - 3	4-7	8 - 13	14 - 19	20+
Potassium ppm	0 - 59	60 - 149	150 - 249	250 - 350	350+
Calcium	0 - 79	80 - 199	200 - 349	350 - 500	500+
Magnesium	0 - 29	30 - 59	60 - 99	100 - 149	150+

Growth Regulators

TABLE 1. Methods of Use of Various Growth Retardants on Seed Geraniums and Bedding Plants.

CROP	MATERIAL	PURPOSE	CONCEN- TRATION	APPLICATION ¹	TIME TO APPLY	REMARKS
Seed Geraniums	A-Rest	Height control and early flow-ering.	200 ppm	Spray 1 gal/ 200 sq ft	2-3 weeks after transplant (35-42 days after seeding).	Promotes branching and early flowering.
	Cycocel	Height control and early flowering.	1,500 ppm	Spray to runoff 1 gal/ 200 sq ft	2-3 weeks after transplanting (35-42 days after seeding).	Promotes branching and early flowering. May cause chlorosis in leaf margins.
Bedding Plants	A-Rest	Height control	100-200 ppm	1 gal/200 sq ft	2-4 weeks after transplanting.	Wide variation in sensitivity of species.
	B-Nine SP	Height control	2,500-5,000 ppm	1 gal/200 sq ft	2-4 weeks after transplanting.	Petunias should be 1½-2 inches in diameter. Tomatoes should have 2-4 times leaves. Alar is registered only for tomatoes among bedding plants.

¹ Apply material to the drip point — in some instances this quantity of material may cover a slightly larger area than indicated in the table.

TABLE 2. Effect of Growth Retardants on Specific

	B-Nine SP ALAR	A-REST
Ageratum	Effective	Effective
Anthirrhinum (Snapdragon)	Effective	Effective
Browallia	Effective	Effective
Celosia	Effective	Effective
Centaurea (Cornflower)	Effective	Effective
Chrysanthemum	Effective	Effective
Cleome	Not Effective	Effective
Coleus	Effective	Effective
Convolvulus (Morning Glory)	Not Effective	Effective
Cucumis (Cucumber)	Effective	Effective
Dahlia	Effective	Effective
Dianthus (Carnation)	Not Effective	Effective
Gomphrena	Not Effective	Not Effectiv
Hedera (English Ivy)	Effective	Effective
Impatiens	Effective	Effective
Lactuca (Lettuce)	Effective	Effective
Lycopersicon (Tomato)	Effective	Effective
Pelargonium (Geranium)	Not Effective	Effective
Petunia	Effective	Effective
Salvia	Effective	Effective
Tagetes (Marigold)	Effective	Effective
Verbena	Effective	Effective
Viola (Pansy)	Not Effective	Not Effectiv
Zinnia	Effective	Effective

the retardant will only retard future growth; it will not make plants that are already tall shorter.

TABLE 4. Amount of Growth Regulator Solution to

	Prepare	to Spray	or Drenc	h.	
POT SIZE (inches)		SPRAY		DRI	ENCH
	pots/sq ft	ml/pot	pots/gal (200 sq ft)	oz/pot	pots/gal
21/4	20	1	3780	1	128
4	6	3	1260	3	42
5	3	6	630	4	32
6	2	10	375	6	21
6	1	20	189	10	13
Standard Bedding					
Flat	0.5	.36	100		-

TABLE 3. Dilution Rates and Concentrations of Cycocel (11.8 percent active ingredient).

CONCENTRATION percent ppm		DILU	TION	APPROX. RATIO CYCOCEL: WATER	
		oz/gal of solution	ml/liter of solution		
0.10	1000	1.1	8.5	1:100	
0.15	1500	1.6	12.7	1:80	
0.20	2000	2.2	17.0	1:60	
0.25	2500	2.7	21.2	1:50	
0.30	3000	3.3	25.4	1:40	
0.40	4000	4.4	34.0	1:30	
0.50	5000	5.4	42.4	1:25	

SUGGESTIONS FOR PROPER USE OF GROWTH REGULATORS

- 1. Apply the proper growth regulator to the proper plant at the proper time and at the proper applica-
- 2. Be sure to apply uniformly, either as a foliar spray or by thorough soaking the soil mass when drench-
- 3. Although more difficult to apply, a single drench of Cycocel or A-Rest will generally be more effective than spray treatments. NOTE: Some reports indicate soil applications may be tied-up or inactivated by pine bark or other organic matter in the medium thus reducing effectiveness.
- 4. If possible, use two split applications of half-strength rather than one application at full strength to apply the same amount to active ingredient. This is especially true when using either Cycocel or A-Rest.
- 5. Before applying any growth regulator, be sure that the plant is well established with a good root sys tem. Growth regulators are not substitutes for poor
- 6. As growers, you will see many articles and recommendations for non-registered uses of various growth regulators and crops. It is your responsibility to read the labeled uses of the material and use them accordingly. Common sense should always be exercised when using growth regulators.

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TABLE 5. Dilution and Dosage Rates for Concentrations of A-Rest (0.0264 Percent Active Ingredients) Used for FOLIAR SPRAYS.

		DILUTION			DOSAGE (mg/pot) ¹				
CONCEN percent	TRATION ppm	oz/gal of solution	ml/liter of solution	Approx. Ratio A-Rest: Water	pot - 2¼ inches rate - 1 ml/pot space - 20 pots/ sq ft	4 inches 3 ml/pot 6 pots/ sq ft	5 inches 6 ml/pot 3 pots/ sq ft	6 inches 10 ml/pot 2 pots/ sq ft	8 inches 20 ml/pot 1 pot sq ft
0.0010	10	4.9	-38	1:25	0.010	0.030	0.06	0.10	0.2
0.0025	25	12.1	95	1:10	0.025	0.075	0.15	0.25	0.5
0.0050	58	24.2	190	1:5	0.050	0.150	0.30	0.50	1.0
0.0100	100	48.5	380	1:25	0.100	0.300	0.60	1.00	2.0
0.0200	200	97.0	760	1:1.25	0.20	0.600	1.20	2.00	4.0

¹ Dosage based on recommendations of 1 gal spray applied to 200 sq ft (1 liter/5 sq m) at close spacing but not necessarily final spacing.

TABLE 6. Dilution and Dosage Rates for Concentrations of A-Rest (0.0265 Percent Active Ingredients) Used for SOIL DRENCHES.

		DILUTION			DOSAGE (mg/pot) ¹				
CONCENT.	FRATION ppm	oz/gal of solution	ml/liter of solution	Approx. Ratio A-Rest: Water	pot - 2½ inches rate - 1 oz or 30 ml	4 inches 3 oz or 90 ml	5 inches 4 oz or 120 ml	6 inches 6 oz or 180 ml	8 inches 10 oz or 300 ml
0.00005	0.5	0.3	1.9	1:500	0.015	0.045	0.06	0.09	0.15
0.00010	1.0	0.5	3.8	1:250	0.030	0.090	0.12	0.18	0.30
0.00025	2.5	1.3	9.5	1:100	0.075	0.225	0.30	0.45	0.75
0.00050	5.0	2.5	19.0	1:50	0.150	0.450	0.60	0.90	1.50

TABLE 7. B-Nine SP or Alar-85 (85 Percent Active Ingredient)

100			9	
	STOCK SOLUTION ¹ (CONCENTRATION)		B-Nine SP or ALAR-85/ GAL OF FINAL STOCK SOLUTION	B-Nine SP or ALAR-85/ LITER OF FINAL STOCK SOLUTION
	5 percent		8 ounces	59 grams
	Spray Solution		fl oz of 5% solution/ gal of final solution	ml of 5% solution/ liter of final solution
From	2,500 ppm		6.5	50
Stock	5,000 ppm		13.0	100
Solution	7,500 ppm		20.0	150
	Comme Calation	tsp/gal	oz of B-Nine SP or Alar-85/	gm of B-Nine SP or Alar-85/
	Spray Solution	of solution	10 gal of final solution	liter of final solution
From	2,500 ppm	5.0^{2}	4.0	3.0
Stock	5,000 ppm	10.0	8.0	6.0
Powder	7,500 ppm	15.00	11.0	9.0

² Approximate dosage only. Use weight measurement wherever possible

Weed Control

CHEMICALS FOR NON-CROP AREAS

One of the best herbicides on the market. It kills by contact and does not leave a residue. The weeds must be present to achieve control. Do not use near steam pipes or desirable plants.

Amitrol-T: This herbicide should only be used in cold frames or plastic houses that have the plastic removed. It is effective against all weeds, but does have a 4-6 week residue. Under greenhouse conditions, it may not leach away and can cause problems. This material could also be used in a non-crop area outside the green-

(telvar): Diuron

Any of these herbicides kills most weeds. Acting through the roots, they are most effective against young weeds and less effective against (karmex): older weeds. Because they are long-lasting Simazine herbicides, they must not be applied on soil that will be used for crops in the next 2-3 years. Do not spray on heating pipes. Do not place pots or flats on soil treated with one of these herbicides.

Round-Up: An effective herbicide for grasses in non-crop areas. This material would be effective in controlling quackgrass around the outside of the

greenhouses. None of these materials have a label for use in greenhouses. They can be legally used for weed control around the outside of greenhouses.

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