

AG-FO-1883—Revised 1990

# COMMERCIAL VEGETABLE Weed, Insect, and Disease Control Guide: Cabbage, Broccoli, Cauliflower, Brussels Sprouts

W. D. Hutchison; F. L. Pflieger; Leonard B. Hertz; and J. D. Pokorny

Pesticide suggestions in this guide are based on current state and federal registrations and tolerances set by the Environmental Protection Agency (EPA). *Directions given in this guide and on current container labels should be read, understood, and followed carefully in order to control pests and diseases effectively without causing excessive residues to remain on the crops.* The following information is up to date at the time of this printing. Information regarding any changes during the 1990 season will be made available to all commercial growers.

Suggestions for sampling and action thresholds are sometimes based on local studies, but are often derived from those of other states in the North Central Region, especially Michigan, due to lack of local data.

This publication is for your information. The University of Minnesota and its officers or employees make no claims or representations that the chemicals discussed will or will not result in residues on agricultural commodities and assume no responsibility for results of their use.

**State and Federal laws require that only certified applicators may use or supervise the application of certain pesticides with restricted uses. Information about certification is available from your county extension agent-agriculture.**

## RATES OF APPLICATION FOR INSECTICIDES AND FUNGICIDES

Sometimes small amounts of insecticides or fungicides are listed in terms of tablespoons and teaspoons. These always mean level measures—not rounded or heaping.

Recommendations may be given in terms of pounds or gallons of commercial preparation or as pounds of active ingredient per acre. "Pounds active ingredient" means the equivalent of 100-percent chemical. For example: 2 pounds of 50-percent methoxychlor wettable

powder contains 1 pound of actual methoxychlor; 4 pounds of a 25-percent wettable powder contains 1 pound of active ingredient, and 20 pounds of a 5-percent dust contains 1 pound of active ingredient.

If you are preparing sprays that contain emulsifiable concentrates, read the label to determine how many pounds of active ingredient are in each gallon of concentrate. For example, 25-percent methoxychlor emulsifiable concentrate contains 2 pounds of active ingredient per gallon. If you wish to apply 1 pound of actual methoxychlor per acre, decide on the amount of liquid you want to apply per acre and add 1/2 gallon of 25-percent methoxychlor concentrate to the amount of water needed for 1 acre.

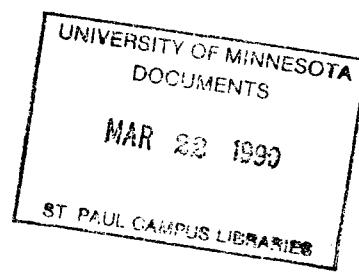
Most insecticides and fungicides can be mixed. Read the label instructions for specific combinations.

## SEEDBED FUMIGATION FOR PLANT DISEASE AND WEED CONTROL

Annual weed seeds and plant disease organisms have been successfully controlled prior to seeding by steam sterilization or fumigation with methyl bromide, SMDC (Vapam), DMTT (mylone), or chloropicrin. The period after treatment before crops can be safely planted will vary depending on moisture and temperature conditions. Fall treatment is often preferable, especially for early spring seeding.

Manufacturer's directions must be followed closely for safety and satisfactory results when using these fumigants. Soil must be worked up before treating. Crop residues must be well-rotted or removed. Soils must be moist and in a good state of tilth at time of treating for best results. Do not disturb the soil below the depth of treatment after treating or the beneficial results likely will be lost.

See Table 1 for specific chemicals and approved uses for soil fumigation.



**Table 1. Characteristics of Nematicides**

Trade name	Active ingredients	Hazards to mammals†		Effective against		
		Oral	Dermal	Nematodes	Soil fungi	Weed seeds
Brozone Brom-O-Sol	methyl bromide (68.6%) chloropicrin (1.4%)		serious inhalation hazard	*	*	*
Chloropicrin Picfume Larvicide Chlor-O-Pic	trichloronitromethane (99%)		serious inhalation hazard	*	*	*
D-D Mixtures D-D Vidden D	1,3-dichloropropene-1,2-dichloropropane and related chlorinated hydrocarbons	moderate	low	*		
Dorlone	ethylene dibromide (18.9%) 1,3-dichloropropenes and related C <sub>3</sub> hydrocarbons (79.9%)	moderate	moderate	*		
Brom-O-Gas	methyl bromide (98%) and chloropicrin (2%)		serious inhalation hazard	*	*	*
Terr-O-Gas	methyl bromide (67%) and chloropicrin (33%)		serious inhalation hazard	*	*	*
Ethylene Dibromide Soilbrom-85	1,2-dibromoethane	moderate	moderate	*		
Ethoprop (Mocap)	O-ethyl, S,S-dipropyl phosphorodithioate	high	high	*		
Telone	1,3-dichloropropene and related chlorinated hydrocarbons (100%)	moderate	moderate	*		
Vapam VPM	sodium methyl dithiocarbamate (32.7%)	low	moderate	*	*	*
Terr-O-Cide 15	1,2-dibromoethane (40%) and chloropicrin (15%) —or—	moderate	moderate	*	*	
Terr-O-Cide 30	1,2-dibromoethane (36%) and chloropicrin (30%)					
Terr-O-Cide 15-D	1,3-dichloropropene-1,2-dichloropropane and other halogenated C <sub>3</sub> compounds (85%) and chloropicrin (15%) —or—	moderate	low	*		
Terr-O-Cide 30-D	1,3-dichloropropene-1,2-dichloropropane and other halogenated C <sub>3</sub> compounds (70%) and chloropicrin (30%)					

†Most fumigants are vesicants which cause severe burns when in contact with skin or mucous membranes. Avoid direct contact and INHALATION of these materials.

**Table 2. 1990 Herbicide Suggestions**

Weeds	Herbicide†	Amount/acre commercial product	Remarks and limitations
<b>DIRECT SEEDED OR TRANSPLANTED</b>			
Germinating grasses and some broadleaves	(trifluralin) Treflan 4 E	1-2 pt.	Apply before seeding or transplanting and incorporate. Lower rate on sandy soils. Not effective on ragweed and mustards or <i>muck soils</i> . Apply after seeding or transplanting, but before weeds emerge. <i>Not effective on muck and peat soils</i> . Apply preplant and incorporate. May be applied after seeding or transplanting but before weeds emerge. Then irrigate and soak soil. Use lower rate on light soil.
	(DCPA) Dacthal 75W	12 lb.	
	(napropamide) Devinol 50W	2-4 lb.	
Emerged annuals and perennials	(glyphosate) Roundup 3E	2-4 pt.	Apply to weeds before or after seeding, but before crop emergence. Use high rate for perennial weed control.
Emerged grasses	(sethoxydim) Poast 1.5E	1-1½ pt.	Use on broccoli, cabbage, and cauliflower only. Apply to actively growing grasses and include 1 qt/A crop oil concentrate.
Emerged annuals	(paraquat) Gramoxone Extra 2.5E	3 pt.	Apply to weeds before planting or after seeding, but before crop emergence.
Germinating broadleaves and some grasses	(oxyfluorfen) Goal 1.6E	1¼-2½ pt.	TRANSPLANTED ONLY. Apply on soil surface prior to transplanting broccoli, cauliflower, or cabbage. Transplant crop within 7 days.

†Abbreviations used in tables: phi—preharvest interval, NTL—no time limitations, B—bait, C—concentrate, D—dust, DF—dry flowable, DG—dry granular, E—emulsifiable concentrate, F—flowable, G—granules, S—solution, SL—soluble liquid, SP—soluble powder, and W—wettable powder. Dosages of insecticides are actual chemical per acre, with some exceptions.

\*Restricted use pesticide. POST TREATED AREAS WHEN REQUIRED BY LABEL.

∞Not for use on Brussels sprouts.

#For use on cabbage only.

**Table 3. 1990 Insecticide Suggestions**

Regularly check 20 randomly selected plants in each of five (or more) locations in the field. Look especially for aphids, flea beetles, larvae of the cabbage looper (CL) and imported cabbageworm (ICW), and cutworms. If diamondback moth (DBM) larvae are abundant, count them too. Cutworms are more likely to be abundant in a weedy field. If you find suspected cutworm damage, check the ground around the plants for hiding worms. Aphids, flea beetles, and cutworms are most damaging to young plants; only a very heavy infestation will cause economic damage to mature plants. Flea beetles tend to have very patchy distributions and a spot or strip treatment may be sufficient to control them.

Caterpillar feeding on young transplants may require control, but rarely. Established plants, with 4 to 5 or more true leaves and not in a field infected with blackrot can tolerate up to 50 percent defoliation until the preheading stage without yield loss. However, both CL and ICW do most of their feeding when they are more than 3/4 inch long, and they are harder to control by then. If several larvae 1/4-3/4 inch long are present per plant, it may pay to treat even at lower levels of defoliation. This may enable use of *Bacillus thuringiensis* (B.t.), which will not induce outbreaks of aphids. If blackrot is present, even early defoliation should be minimized.

Once plants start to head, contamination and yield loss become a concern. Sprays may be necessary immediately prior to blanching in cauliflower, and as close as is safe to harvest in broccoli, to kill potentially contaminating larvae.

Studies have shown that 20 DBM larvae do as much damage as 1 CL larva; likewise 1.5 ICW larvae are equivalent to 1 CL larva. Convert larval counts for each species to CL equivalents and then total to compare with the action threshold below. Good coverage, including the undersurfaces of plants, is necessary when spraying cole crops. Spreader-sticker adjuvants added to sprays are sometimes an advantage. Use of COAX, however, increases leaf feeding, especially with B.t., and is therefore not advised on cole crops.

Most foliar sprays are more effective on cabbage aphid if a wetting agent is used.

Insects	Chemical†	Formulation			Remarks and limitations
		Recommended	Product/acre	Dosage	
Aphids	chlorpyrifos (Lorsban)	50%W	2 lbs	1 lb	21 days phi. Do not mix or apply to plants under extreme heat or drought stress. 7 day phi cabbage and Brussels sprouts; 5 days broccoli and cauliflower. 3 day phi cabbage; 7 days broccoli and cauliflower. Not labeled for Brussels sprouts. 4-day re-entry. One application per season as band on each side of seed furrow or transplanted row, or as sidedressing. Do not apply directly on seed. 42 day phi cabbage; 40 days cauliflower; 14 days broccoli; 30 days Brussels sprouts. 24-hr. re-entry. 7 day phi cabbage; 4 days broccoli; 14 days cauliflower and Brussels sprouts. 24-hr. re-entry. 7 day phi Brussels sprouts, cabbage, and cauliflower; 3 days broccoli. 10 day phi Brussels sprouts; 7 days broccoli, cabbage, and cauliflower. Not more than three times per season. 48-hr. re-entry. 1 day phi broccoli, cabbage; 3 days cauliflower, Brussels sprouts. 28 day phi cauliflower; 21 days broccoli; 14 days Brussels sprouts; 35 days cabbage. 1 day phi. 24-hr re-entry.
	diazinon	50% W	1 lb	1/2 lb	
	dimethoate (Cygon, DeFend, Dimex, Rebelate)	4E	1/2-1 pt	1/4-1/2 lb	
	*disulfoton (Di-Syston)	15G	7.4 oz./1,000 row ft., any row spacing		
	endosulfan (Thiodan)	3E	2 pt	3/4 lb	
	malathion	5E	3/4-1 pt	1/2-3/4 lb	
	oxydemetonmethyl (Meta-Systox-R)	2E	2 pt	1/2 lb	
	*mevinphos	4E	1/2 pt	1/4 lb	
	*methamidophos (Monitor)	4E	1-2 pt	1/2-1 lb	
		naled (Dibrom) pyrethrins + piperonyl butoxide (Pyroicide)	8E 6+60E 1.4S	1 pt 2-6 fl oz 1-2 pt (in 50 or 100 gal)	
Cabbage maggot	chlorpyrifos (Lorsban)	15G 4E	4.6-9.2 oz/1,000 row ft. 1.6-2.4 fl oz/1,000 row ft. in 40 gal water		Not more than one application per season. Do not apply as a foliar. 30 day phi. 24-hr. re-entry for 4E. As furrow drench or in transplant water. Broadcast soil treatment before planting. Broadcast soil treatment before planting.
	diazinon (e.g., AG500)	4E 14G	4-6 pt 28 lb	2-3 lb 4 lb	
	*fonofos (Dyfonate)	20G	20 lb	4 lb	
Cutworms	carbaryl (Sevin)	20%B	5-10 lb	1-2 lb	3 day phi. 21 days phi. Do not mix or apply to plants under extreme heat or drought stress. Broadcast soil treatment before planting.
	chlorpyrifos (Lorsban)	50%W	2 lb	1 lb	
	diazinon	14G	14-21 lb	2-3 lb	
Action threshold: 1--2/100 plants	*esfenvalerate (Asana XL)	0.66E	5.8-9.6 fl oz	0.03-0.05 lb	3 day phi. Do not exceed 0.4 lb. A/acre/season. Not labeled for Brussels sprouts. 21 day phi. Not labeled for broccoli. 24-hr. re-entry for Dylox. 1 day phi.
	trichlorfon (Dylox, Proxol)	80SP	1 1/4 lb	1 lb	
	*permethrin (Ambush, Pounce)	2E 3.2E 25W	6 fl oz 4 fl oz 6 fl oz	0.1 lb	

†Abbreviations used in tables: phi—preharvest interval, NTL—no time limitations, B—bait, C—concentrate, D—dust, DF—dry flowable, DG—dry granular, E—emulsifiable concentrate, F—flowable, G—granules, S—solution, SL—soluble liquid, SP—soluble powder, and W—wettable powder. Dosages of insecticides are actual chemical per acre, with some exceptions.

\*Restricted use pesticide. POST TREATED AREAS WHEN REQUIRED BY LABEL.

‡Not for use on Brussels sprouts.

#For use on cabbage only.

**Table 3. 1990 Insecticide Suggestions (continued)**

Insects	Chemical†	Formulation			Remarks and limitations
		Recommended	Product/acre	Dosage	
Flea beetles Critical stages: seedlings, transplants	carbaryl (Sevin)	XLR plus	1-2 pt	1/2-1 lb	3 day phi.
	chlorpyrifos (Lorsban)	50%W	2 lb	1 lb	21 days phi. Do not mix or apply to plants under extreme heat or drought stress.
	diazinon	50% W	1 lb	1/2 lb	7 day phi cabbage and Brussels sprouts; 5 days broccoli, cauliflower.
	*disulfoton (DiSyston)	15G	7.4 oz./1,000 row ft., any row spacing		One application per season as band on each side of seed furrow or transplanted row, or as sidedressing. Do not apply directly on the seed. 42 day phi cabbage; 40 days cauliflower; 14 days broccoli; 30 days Brussels sprouts. 24-hr. re-entry.
	endosulfan (Thiodan)	3E	2 pt	3/4 lb	7 day phi cabbage, broccoli; 14 days cauliflower and Brussels sprouts. 24-hr. re-entry.
Cabbageworm, loopers & diamond back moth	*esfenvalerate (Asana XL)	0.66E	5.8-9.6 fl oz	0.03-0.05 lb	3 day phi. Do not exceed 0.4 lb. Al/acre/season. Not labeled for Brussels sprouts.
	methoxychlor	2E	3 pt	1 1/2 lb	3 day phi cabbage; 7 days cauliflower; 14 days broccoli, Brussels sprouts.
	<i>Bacillus thuringiensis</i> (Biotrol, Dipel, Thuricide) as labeled	e.g., 6.2% W	1/8-1/2 lb	.12-.5 oz	N.T.L. B.t. is generally more effective on very young larvae than older ones, and more effective on imported cabbageworm than on cabbage loopers. It may successfully control young larvae of either species if numbers are not too high and weather conditions are favorable.
	*azinphosmethyl (Guthion)	2E	3 pt	3/4 lb	21 day phi cabbage, 15 days broccoli and cauliflower, 7 days Brussels sprouts. 24-hr. re-entry.
	carbaryl (Sevin) chlorpyrifos (Lorsban)	XLR plus 50WP	1 1/2-2 pt 2 lb	3/4-1 lb 1.0 lb	3 day phi. 21 day phi. Do not mix or apply to plants under extreme heat or drought stress.
	endosulfan (Thiodan)	3E	1 pt.	3/4 lb	See remarks and limitations under aphids.
	*esfenvalerate (Asana XL)	0.66E	2.9-9.6 fl oz	0.015-0.05	3 day phi. Do not exceed 0.4 lb. active ingredient/acre/season. NOT labeled for Brussels sprouts for DBM. For ICW, use 2.9-5.8 fl oz/acre; for CL use 5.8-9.6 fl oz/acre.
	*methomyl (Lannate)	90SP L LV	1/2-1 lb 2-4 pt 1.7-3 pt	0.45-0.90 lb	1 day phi cabbage; 3 days broccoli, cauliflower, and Brussels sprouts. Wetting agent advised, all formulations. 90SP not restricted use.
	*parathion (Niran, parathion)	25% W	1 lb	1/4 lb	7 day phi. May be combined with endosulfan. 48 hr. re-entry.
	*mevinphos	4E	1/2-1 pt	1/4-1/2 lb	1 day phi broccoli, cabbage; 3 days cauliflower and Brussels sprouts.
naled (Dibrom)	8E	1-2 pt	1-2 lb	1 day phi. 2 lb. rate is for loopers, lower rates for others. 24-hr. re-entry.	
Action threshold: 0.5 CL equiv./head. Reduce threshold if less effective insecticide, suboptimal application, or blackrot present.	*permethrin (Ambush, Pounce)	3.2E 2E	2-4 fl oz 3-6 fl oz	0.05-0.1 lb	1 day phi. Not more than 8 applications. Do not exceed 1.0 lb. Al/acre/season on cabbage.
	pyrethrins + piperonyl butoxide (Pyrocide)	6 + 60E 1.4S	2-6 fl oz 1-2 pt (in 50 or 100 gal.)		N.T.L.
	trichlorfon (Dylox, Proxol)	80SP	1 1/4 lb	1 lb	21 day phi. Not labeled for broccoli. 24-hr. re-entry for Dylox.

**Table 4. 1990 Fungicide Suggestions**

Diseases	Chemical†	Remarks
Seed rot, damping-off	Captan, Thiram	There are several fungicide formulations for seed treatments made by several different companies. Read and follow all label instructions.
<b>CABBAGE, BROCCOLI, CAULIFLOWER</b>		
Plant bed treatment:		
Alternaria and downy mildew	Bravo, Basic Copper Sulfate	
Pythium, Phytophthora	Ridomil 2E	Either preplant or incorporated at planting. See label.
Foliar treatment:		
Downy mildew	Ridomil/Bravo 81W	Begin applications when plants start emerging in direct seeded crops, after transplants are set on the field, or when conditions are favorable for disease development. Continue applications at 14-day intervals until threat of disease is over. See label.
Alternaria		

†Abbreviations used in tables: phi—preharvest interval, NTL—no time limitations, B—bait, C—concentrate, D—dust, E—emulsifiable concentrate, F—flowable, G—granules, S—solution, SL—soluble liquid, SP—soluble powder, and W—wetable powder. Dosages of insecticides are actual chemical per acre, with some exceptions.

\*Restricted use pesticide. POST TREATED AREAS WHEN REQUIRED BY LABEL.

‡Not for use on Brussels sprouts.

§For use on cabbage only.

**Table 4. 1990 Fungicide Suggestions (continued)**

Diseases	Chemical†	Remarks and limitations
CABBAGE, BROCCOLI, CAULIFLOWER, BRUSSELS SPROUTS Foliar treatment: Alternaria and downy mildew Soil treatment: Rhizoctonia wire stem, clubroot	Bravo, Basic Copper Sulfate, Kocide 606 F Terraclor 10G, Terraclor 75 WP	Bravo is available in the following formulations: Bravo 500, Bravo 720, Bravo Flowable, and Bravo W-75 See label for additional information.
CABBAGE ONLY Black rot (bacteria) Alternaria	Kocide 101, Kocide 606 F Kocide 606, Kocide 101	Crop rotation and sanitation are necessary. Plant disease-free seed. Symptoms of the disease are yellow v-shaped areas on the leaf margin.
Sclerotinia	Benlate 50 DF	Begin applications at first petal fall; make 2 additional applications at 14-day intervals if conditions favor disease development.
Downy mildew	Kocide 101	
Turnip mosaic (internal spotting of cabbage seed)		Control aphids; see insect control above.

†Abbreviations used in tables: phi—preharvest interval, NTL—no time limitations, B—bait, C—concentrate, D—dust, DF—dry flowable, DG—dry granular, E—emulsifiable concentrate, F—flowable, G—granules, S—solution, SL—soluble liquid, SP—soluble powder, and W—wetable powder. Dosages of insecticides are actual chemical per acre, with some exceptions.

\*Restricted use pesticide. POST TREATED AREAS WHEN REQUIRED BY LABEL.

∞Not for use on Brussels sprouts.

#For use on cabbage only.

#### CHEMIGATION OF PESTICIDES

Minnesota Pesticide Control Law as of 1988 requires each chemigation system used for applying pesticides with the irrigation water to be registered with the Minnesota Department of Agriculture (MDA) and contain the necessary approved anti-pollution check valves. Only pesticides displaying product label approval for chemigation application can be applied by this method. Minnesota law also requires the treated field to be posted throughout the period of chemigation application for any pesticide. Chemigation has the potential to allow the injected chemical to backflow into the water source when the irrigation pump shuts down if proper check valves and interlocks are not in place or maintained. Specific information on check valves and registration is available from the MDA (612/297-2614).

Chemigation can be an effective application method if the needed pesticide is suited for this practice and the irrigation and chemigation system is properly engineered and maintained. Accurate calibration of the irrigation system and the desired pesticide application rate is most important. Information on how to determine the chemical injection rate is available from the manufacturer and the Minnesota Extension Service offices.

**Do not use after 1990.**

---

W. D. Hutchison is extension entomologist and assistant professor, Department of Entomology; F.L. Pflieger is extension plant pathologist and associate professor, Department of Plant Pathology; Leonard B. Hertz is extension horticulturist and professor, Department of Horticultural Science; and J.D. Pokorny is director, Plant Disease Clinic, Department of Plant Pathology. The authors acknowledge the contributions of Dave Noetzel, extension entomologist, in the development of previous versions of this publication as well as the assistance of other members of these departments.

---

The information given in this publication is for educational purposes only. Reference to commercial products or trade names is made with the understanding that no discrimination is intended and no endorsement by the Minnesota Extension Service is implied. Issued in furtherance of cooperative extension work in agriculture and home economics, acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture. Patrick J. Borich, Dean and Director of Minnesota Extension Service, University of Minnesota, St. Paul, Minnesota 55108. The University of Minnesota, including the Minnesota Extension Service, is committed to the policy that all persons shall have equal access to its programs, facilities, and employment without regard to race, religion, color, sex, national origin, handicap, age, veteran status, or sexual orientation.