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Insecticide Suggestions To Control Insect Pests Of Field Crops In 1979

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AGRICULTURAL EXTENSION SERVICE
UNIVERSITY OF MINNESOTA

Insecticide Suggestions To Control Insect Pests Of Field Crops In 1979

Legal Restrictions on Use of Pesticides

In October 1977 certain provisions of the 1972 Federal Insecticide, Fungicide and Rodenticide Act became effective.

In part, this, and the Minnesota Pesticide Act of 1976, require that those who use or supervise the use of certain pesticides with restricted uses must be certified.

The labels of those pesticides with restricted uses will contain information regarding these restrictions. Be sure to read all labels thoroughly and use any pesticide for the crops and pests listed on the label only. The new law makes it illegal to use any pesticide in a way which is inconsistent with the label directions.

Information about applicator certification may be obtained from your County Extension Director or the Minnesota Department of Agriculture. The U.S. Environmental Protection Agency (EPA) has listed the following as restricted-use insecticides:

Aldicarb (Temik)
Aluminum phosphide (Phostoxin)
Azinphos methyl (Guthion)
Calcium cyanide
Demeton (Systox)
Endrin
Ethyl parathion
Methomyl (Lannate, Nudrin)

Methyl bromide
Methyl parathion
Mevinphos (Phosdrin)
Sodium cyanide
Sulfotepp
Tepp

Others may be restricted during the year. In addition, the Minnesota Department of Agriculture has classified lindane, some arsenicals, and some rodenticides as restricted.

Carbaryl (Sevin), ULV Malathion, Methidathion (Supracide), Methyl parathion (Penncap M) and parathion are very toxic to bees. Crops in bloom should not be treated and applications should not be made near bee yards or when bees are present in the field to be treated.

Aldicarb (Temik), demeton (Systox), disulfoton (Di-Syston), mevinphos (Phosdrin), methomyl methyl parathion, parathion, phorate (Thimet), and phosphamidon (Dimecron) are **highly toxic** chemicals and should be used only by persons acquainted with the necessary precautions for their safe use. The granular formulations are less hazardous to the operator than are the liquids. Avoid inhalation of dusts or vapors and contact with the skin. Follow directions on the labels for the use of protective clothing and other safety measures.

The suggestions in this publication include only the use of insecticides for controlling insect pests of field crops.

Other practices—such as crop rotation, time of planting, and appropriate selection of varieties—should also be considered. In most situations, the use of insecticides is only part of a total effort to keep insect pests below the economic injury level.

Where information is available, economic thresholds have been indicated in this publication. These are general guidelines that will vary, depending on stage of development of the crop, growing conditions, value of the crop, and other factors.

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with the U.S. Department of Agriculture. Roland H. Abraham, Director of Agricultural Extension Service, University of Minnesota, St. Paul, Minnesota 55108. The University of Minnesota, including the Agricultural Extension Service, is committed to the policy that all persons shall have access to its programs, facilities, and employment without regard to race, creed, color, sex, national origin, or handicap.

Crop	Insect	Insecticide	Dosage	Limitations, remarks (Days before harvest)	
Alfalfa	Alfalfa weevil	azinthosmethyl (Guthion)	½ — ¾ lb.	21 days, one application per cutting	
		carbofuran (Furadan)	¼ — ½ lb.	7 days ¼ lb., 14 days ½ lb.	
		methyl parathion	¼ lb.	15 days	
		Imidan	1 lb.	7 days, one application per cutting	
		diazinon plus methoxychlor	½ lb. + 1 lb.	7 days — available as a ready-to-use mixture	
		malathion plus methoxychlor	¾ lb. + ¾ lb.	7 days — available as a ready-to-use mixture	
		methidathion (Supracide)	½ lb.	10 days	
		Cut first crop early to avoid most losses. Treat when over 30% of plant tips show feeding. Treat stubble if there are more than 8 larvae per sq. ft. or when regrowth has 50% of the terminals with feeding or if larvae are delaying regrowth. Do not treat alfalfa in bloom.			
		Aphids and leafhoppers	diazinon	½ lb.	7 days
			dimethoate (Cygort, De-Fend, Rebe-late, Dimex 267)	¼ — ½ lb.	10 days. One application per cutting.
	malathion		1 lb.	No time limitations	
	parathion		¼ lb.	15 days	
	Control aphids when thick enough to cause wilting, usually during drought. Spotted alfalfa aphids may severely damage new seedlings.				
	Armyworm, cutworms	carbaryl (Sevin)	1½ lb.	No time limitations, spray or bait	
		malathion	1 lb. (or ULV)	No time limitations	
	Leafhoppers	trichlorfon (Dylox)	1 lb. spray or bait	7 days — spray	
		Treat when over 5 per sq. ft.		14 days — bait	
		azinthosmethyl	¼ to ½ lb.	14 days	
		carbaryl	1 lb.	No time limitations	
		diazinon	½ lb.	7 days	
		methoxychlor	1 lb.	7 days	
malathion		1 lb.	No time limitations		
Grasshoppers	methidathion (Supracide)	½ lb.	10 days		
	Apply when regrowth after first cutting is 8 to 12 inches and leafhoppers are over 2 per net sweep. Treatment of third crop may be warranted in some cases. Combinations of methoxychlor with diazinon or malathion are also available.				
	azinthosmethyl	½ to ¾ lb.	21 days		
	carbaryl	1 to 1½ lb.	No limitations		
	carbofuran	2 to 4 oz.	7 days, one application per season.		
	diazinon	½ lb.	7 days		
	dimethoate	¼ to ½ lb.	10 days. One application per cutting.		
	malathion	1½ lb. or ½ lb. technical as ULV	5 days, ULV		
			by air	No time limitations	
	Control when there are over 8 grasshoppers per sq. yd. in the field or treat margins after cutting at more than 20 per sq. yd.				
Spittlebug	methoxychlor	1 lb.	7 days		
Plant bugs	Apply on first crop when spittle masses average more than one per stem.				
	malathion + methoxychlor	¾ lb. + ¾ lb.	7 days		
	trichlorfon	1 lb.	7 days		
	diazinon + methoxychlor	½ lb. + 1 lb.	7 days		
Alfalfa, clover (for seed only)	Plant bugs	Control seldom needed except on seed crop. Cut early to avoid injury. Do not harvest for forage or graze.			
		endosulfan (Thiodan)	1 lb.		
		toxaphene	2 lb.	Do not treat crop in bloom.	

Crop	Insect	Insecticide	Dosage	Limitations, remarks (Days before harvest)	
Corn, field	Aphids	malathion	1 lb.	5 days	
		methyl parathion	4 oz.	3 days } Aerial application only 12 days }	
		parathion	4 oz.		
		phorate (Thimet)	1 lb.	Granules applied in the whorl just before tasselling.	
		disulfoton (Di Syston)	1 lb.	Granules 40 days	
			disulfoton	½ lb.	Spray 28 days.
			Chemical control of cornleaf aphids is seldom economically justified. If 10% of the plants have over 500 aphids per plant prior to tasselling during drought stress treatment may pay.		
	Armyworm	carbaryl (Sevin)	1½ to 2 lb.	No time limitations	
		malathion	1 to 1½ lb.	5 days	
		methomyl (Lannate)	¼ to ½ lb.	3 days, forage	
toxaphene		2 lb.	Do not feed stalks, leaves, or husks. No limitation for grain.		
trichlorfon		1 lb.	No time limitations		
		Treat when over 10% of the plants are infested. Higher rates for large worms.			
Corn rootworm larvae	carbofuran (Furadan)	1 lb.	} Planting time application of granules in 7-inch band over the row. Do not place in direct contact with the seed. Band of granules should be covered lightly. Some liquid formulations are registered. If these are used with a starter fertilizer, be certain they mix properly, are kept agitated, and are placed in a split band away from the seed. Cultivation time applications of materials registered for such use may be made after rootworm eggs hatch in June. Apply at base of stalks and cover with soil. This method is not effective during dry conditions and should be used as an emergency treatment only. Rates given are for 40-inch row spacing.		
	chlorpyrifos (Lorsban)	1 lb.			
	ethoprop (Mocap) fensulfothion (Dasanit)	1 lb.			
	fonofos (Dyfonate)	1 lb.			
	phorate (Thimet)	1 lb.			
	terbufos (Counter)	1 lb.			
	oftanol (if registered)	1 lb.			
		Rootworm control using chemicals may not be satisfactory in conditions of heavy infestation. In such situations, it is best to rotate to a crop other than corn. In some cases an insecticide may give inadequate control after several years of consecutive use. If this is observed, a switch to different products may give improved results. This problem has been observed especially with carbamates Bux and carbofuran.			
Corn rootworm adults	carbaryl	1 lb.	No time limitations. Sevin-4 oil or dilute		
	diazinon	1 lb.	No time limitations		
	malathion	1 lb.	5 days		
	malathion ULV	4 to 8 oz. as technical by air	5 days		
		Treat when beetles are damaging silks enough to prevent proper pollination. This is usually 10 or more beetles per plant and before 50% of the silks emerge. Seed fields may need treatment more than production fields.			

Crop	Insect	Insecticide	Dosage	Limitations, remarks (Days before harvest)	
Corn	Cutworms, webworms	carbaryl spray or bait	1 to 2 lb.	Post emergence spray to cover approximately 12-inch band at base of plants in at least 15 gal. total spray per acre. Limitations same as for armyworm. Carbaryl bait is more effective than sprays for cutworms except under very dry conditions. These surface treatments are usually ineffective against subterranean species such as glassy cutworm. Broadcast by air or ground equipment.	
		trichlorfon (Dylox)	1 lb.		
		toxaphene	2 lb.		
		If registered: chlorpyrifos (Lorsban 4E)	1 to 1½ lb.		
		Apply when over 10% of the plants are infested or over 3% are cut. NOTE: chlorpyrifos (Lorsban 15G) is registered for cutworm control and may give control when applied at planting time as for rootworm control.			
	European corn borer	carbaryl	1½ lb.		Spray or granules, no time limitations.
		carbofuran	1 lb.		Granules. No more than 2 applications.
		diazinon	1 lb.		Granules. No time limitations grain, 10 days forage.
		fonofos (Dyfonate)	1 lb.		Granules. 30 days.
	Grasshoppers	phorate	1 lb.		As granules.
		toxaphene	2 lb.		As granules. Use on corn for grain only.
		Treat when 50% of whorl leaves show shot-holing for first brood.			
		carbaryl	1½ lb.		No time limitations.
		diazinon	½ lb.		No time limitations.
		malathion	1 lb. or ½ lb. technical as ULV		5 days
Seed-corn maggot, seed-corn beetle, wireworms	toxaphene	1½ lb.	For grain only, no time limitations.		
	Treat field margins early when grasshoppers are small.				
Seed-corn maggots, beetles	heptachlor, lindane	1 oz. per bu.	Seed treatment only. Will not control heavy wireworm infestations.		
	Wireworm	fensulfothion (Dasanit)	1 lb.	Band in row at planting time as for rootworm.	
fonofos (Dyfonate)		1 lb.			
Small grains	Aphids	carbaryl (Furadan)	2 lb.	In furrow at planting time	
		ethoprop (Mocap)	1 lb.	As for rootworm.	
		phorate	1 lb.	As for rootworm.	
		terbufos (Counter)	1 lb.	As for rootworm or in furrow.	
		diazinon	4 lb.		
		fonofos (Dyfonate)	4 lb.	Broadcast, disc in before planting.	
		malathion	1 lb.		
		methyl parathion	4 oz.	No limitations.	
		methyl parathion (Penncap M)	6 to 8 oz.	15 days	
		parathion	4 oz.	15 days	
dimethoate	¼ to ½ lb.	Wheat only. 60 days.			
disulfoton	¼ to ¾ lb.	30 days. For wheat only. Do not graze.			
	Treatment most economical before heading with over 100 aphids per ft. of row.				
Armyworm, cutworms	malathion	1½ lb.	7 days		
	trichlorfon (Dylox)		21 days, maximum of 3 applications.		
	toxaphene	2 lb.	Use for grain only.		
	Treat when number of worms exceeds 5 per sq. ft.				

Crop	Insect	Insecticide	Dosage	Limitations, remarks (Days before harvest)	
Small grains	Grasshoppers	malathion	1 lb. or ½ lb. as technical by air	7 days	
		methyl parathion (PennCap M)	½ lb.	15 days	
		toxaphene	1½ lb.	Use for grain only. Treat when over 8 per sq. yd. in field or over 20 in margins.	
	Wireworms	heptachlor or lindane	1 oz. per bu.	Seed treatment only.	
Barley	Thrips	parathion or methyl parathion by air	6 oz.	15 days. Apply just at heading when there are 4 or more adult thrips per plant.	
Flax	Cutworms, crickets	trichlorfon	1 lb.	21 days	
Soybeans	Bean leaf beetle, flea beetles, blister beetles	carbaryl (Sevin, Sevimol)	1 lb.	No limitations.	
		Treat when defoliation exceeds 25% during pod fill or seedling stage or when pod feeding is extensive.			
	Cutworms, Armyworms	carbaryl	1½ lb.	No limitations.	
		toxaphene	1½ lb.	21 days. Do not feed treated plants.	
	Grasshoppers	carbaryl	1½ lb.	No limitations.	
		malathion	½ lb. technical as ULV by air	7 days	
	Green cloverworm		toxaphene	1½ lb.	21 days. Do not feed treated plants.
			azinphosmethyl Bacillus thuringiensis (Dipel, Thuricide)	6 to 8 oz.	45 days.
			carbaryl	1 lb.	As labeled. No limitations.
			malathion	1 lb.	7 days
Treat when defoliation exceeds 25% or when worms number more than 15 per foot of row during pod fill.					
	Leafhoppers	malathion	1 lb.	7 days	
Sugarbeets	Webworm	carbaryl (Sevin)	1½ lb.	14 days, tops.	
		endosulfan (Thiodan)	1 lb.	Do not feed tops.	
		parathion	4 to 8 oz.	15 days	
		trichlorfon (Dylox)	1 lb.	14 days	
	Treat when worms exceed 5 per sq. ft.				
	Cutworms		carbaryl	2 lb. spray 1 to 2 lb. bait	14 days, tops. Bait formulation preferred.
			trichlorfon	1 lb.	14 days
	Root maggots		aldicarb (Temik)	1½ lb.	Row treatment at seeding time. Place granules above seed in 5 to 7 inch band or as furrow treatment above seed. Some products may also be sidedressed at time of fly emergence. Check labels.
			carbofuran	2 lb.	
			fensulfothian (Dasanit)	1 to 2 lb. 2 lb.	
diazinon			1 lb.		
fonofos (Dyfonate)			1 to 1½ lb.		
Wireworms		phorate (Thimet)	1 lb.		
		lindane	1 oz. per bu.	Seed treatment only.	

Crop	Insect	Insecticide	Dosage	Limitations, remarks (Days before harvest)	
Sorghum	Greenbugs	ethyl parathion	½ lb.	12 days, aerial application. Methyl parathion may cause plant injury.	
		dimethoate	¼ to ½ lb.	28 days	
		disulfoton	½ to 1 lb.	7 days (grain). May be as granules at planting.	
		malathion	1 lb.	7 days	
		Meta Systox R phorate	¼ to ½ lb.	21 days.	
	Wireworms	heptachlor or lindane	½ to 1 oz. per bu.	28 days	
				Seed treatment	
Sunflowers	Sunflower moth larvae	endosulfan (Thiodan)	1 lb.	Not more than 3 applications. Do not feed treated plants. No limitations on use of seeds. Highly toxic to bees.	
		methidathion (Supracide)	½ lb.	2 or 3 treatments at least 50 days before harvest.	
		methyl parathion	1 lb.	No more than 3 applications. 5 day intervals 30 days before harvest. Highly toxic to bees.	
			One larva per head in every plant in the field will cause approximately 15 lb. per acre yield reduction.		
		Grasshoppers, cutworms, sunflower beetles, thistle caterpillars Stem weevil	toxaphene	1½ to 2 lb.	No more than 2 applications. Do not graze or feed plant parts. No time limitations for seed. Higher rates for cutworms and grasshoppers. Plants can be defoliated at least 25% with no yield reduction.
			methidathion (Supracide)	½ lb.	50 days before harvest.
Wild rice (in paddies)	Wild rice worm	2 adults/plant at 6 to 10 leaf stage			
		malathion	1 lb.	21 days before harvest.	
Bluegrass (for seed)	Plant bugs (Capsus)		One larva per head = 11% damaged kernels per head.		
		diazinon	½ lb.	No time limitations	
Bluegrass, Timothy (for seed)	Meadow plant bug	malathion	¾ lb.	No time limitations	
			Treat as heads emerge when Capsus bugs are detected or at first sign of silver top.		
		malathion	¾ lb.	No time limitations	
			Treat at early heading stage when there is an average of two bugs per net sweep.		
	Armyworm	carbaryl	1½ lb.	No time limitations	
		malathion	1 lb.	No time limitations	
			Treat when there are 5 worms per sq. ft.		

Stored Grain Insects

Grain in Minnesota is relatively safe from infestation by stored grain insects before harvest. The only exception may be where grain is cut and swathed adjacent to storage bins being treated with an insecticide or fumigated in preparation for the new crop. Stored-grain insects will migrate from treated bins, at least temporarily.

Accumulations of post-harvest grain or grain products is a primary target for insect infestations especially if it is stored with or adjacent to last year's crop.

Inspect grain at 7-day intervals, during the summer and autumn months, to determine if treatment is needed. Check for insects by taking the grain temperature and by looking for the insects themselves. To take the grain temperature, fasten a thermometer to a stick and sink it into the grain 2 feet below the surface or determine the grain temperature by placing a thermometer in the exhaust air from the aeration system. If insects are active, the temperature will be above 65°F, and may range as high as 100°F. To inspect for insects, insert a grain probe in the center of the bin 2 feet below the grain surface. Sift the grain samples through a 10 to 12 mesh-to-the-inch screen to separate out insects.

Prevention

Spraying Facilities:

Thoroughly clean combines, trucks, wagon beds, elevators, and bins. Spray the surfaces of the equipment that will be in contact with the grain with one of the following insecticides 2 to 6 weeks before harvest:

Pesticide formulation	Amount of pesticide formulation per 2 gallons of water
methoxychlor 50% W.P.	12 oz.
or	
methoxychlor 25% E.C.	1 qt.
or	
pyrethrins 6% E.C. com- bined with piperonyl butoxide 60%	1½ pts.
or	
malathion — premium grade (Cythion) 57% E.C.	½ pt.

oz. = ounce
qt. = quart
pt. = pint

W.P. = wettable powder
E.C. = emulsifiable concentrate

Spray to the point of run-off using 1 gallon of total formulation (one of the insecticides listed above) per 500 sq. ft. of surface. Also spray, if possible, the outside walls of the bins to a height of 6 feet and the ground to a distance of 6 feet out from the foundation of each bin.

If it is not possible to remove the old grain, then it should be checked carefully for stored-grain insects and, if needed, treated with recommended residual insecticides or fumigants before adding new grain.

Grain stored with less than 12% moisture, below 70° F. and with a low amount of dockage or cracked grain is relatively safe from significant damage by stored-grain insects.

Grain Protectants:

Insect infestations are prevented or reduced by treating small grains and shelled corn as it is moved into storage. Treatment may be delayed until spring if air temperatures moved through the grain by adequate aeration systems will cool the grain down to 50°F within a few days' time.

malathion	1 pt. premium-grade E.C. per 2 to 5 gal. water per 1,000 bu.
malathion	1% premium-grade wheat flour dust, 60 lb. per 1,000 bu.
synergized pyrethrins	1 qt. of pyrethrins 6% combined with piperonyl butoxide 60% E.C. in 3 to 5 gal. of water per 1,000 bu. Spray onto the grain stream as it goes into storage.

Surface Grain Treatments:

malathion	½ to 1 pint premium-grade E.C. in 2 gal. water per 1,000 sq. ft. of grain surface area.
malathion	1% premium-grade wheat flour dust, 30 lb. per 1,000 sq. ft.
synergized pyrethrins	8 oz. of pyrethrins 6% combined with piperonyl butoxide 60% E.C. in 1 to 2 gal. of water per 1,000 sq. ft. of grain surface.

Apply the spray evenly over the surface immediately after the grain is loaded into storage and leveled off. Overfilling the bin to peak if above the vertical bin walls will not allow adequate inspection or treatment.

The Indian-meal moth is generally found in the top 6 to 12 inches of stored shelled corn. At the same time there is evidence from some areas that this moth is developing resistance to malathion. If malathion is ineffective, apply synergized pyrethrins, fumigants, or a refined mineral oil. The mineral oil must be unsulfonated, technically white, 100-200 seconds viscosity, and free of objectionable odors. Two quarts of the mineral oil should be applied per 100 square feet of corn surface.

A new preventative treatment for Indian-meal moths is to suspend 1 dichlorvos (Vapona) "No-Pest Strip" per 1,000 cubic ft. of space over the binned grain. The dichlorvos is effective against adult moths only. These "Vapona" strips must be in place before moths begin to emerge in early spring. This treatment is usually effective for 3 months.

Control

Fumigation: Fumigants¹ are applied to binned grain to stop established insect infestations. Best fumigation results are obtainable using the following guidelines:

1. Level the grain. Remove or breakup any crust on the grain surface.
2. Seal all cracks making the bin as air-tight as possible.
3. Fumigate on a still day preferably when the **grain** temperature is above 70° F. Wind causes rapid leakage of the gas and insect kill may be poor.
4. Methods of applying fumigants vary with the type of fumigant, commodity and storage facility. Most farm storages use the gravity penetration method. Apply the correct amount of liquid fumigant evenly over the surface of the grain. Cover the grain with a tarpaulin if the bin is not full.
5. The operator should stay out of the bin if applying liquid grain fumigants. Phosphine formulations allow 1-2 hours before phosphine is generated. Do not breathe vapor or fumes. Use a recommended gas mask with canister, and always work in pairs.
6. Keep the bin closed for at least 72 hours. *Do not enter* the bin during or after fumigation until the fumigant has been allowed to dissipate.
7. When under fumigation, the storage bins should be locked and identified with "DANGER — KEEP OUT" signs to prevent entry and avoid accidents.

Some of the recommended fumigant dosages are tabulated below:

Fumigant	Dosage (gal. per 1,000 bu.)			
	Small grain		Shelled corn	
	Wooden bins	Metal bins	Wooden bins	Metal bins
Carbon tetrachloride-carbon disulfide, 80-20	4	2	6	3
Carbon tetrachloride-ethylene dibromide, 95-5	4	2	8	4
Carbon tetrachloride-ethylene dichloride, 3-1	6	3	8	4
Carbon tetrachloride-ethylene dichloride-ethylene dibromide, 60-35-5	4	2	8	4

¹ Fumigants, being highly toxic, are or will be restricted and require the certification of applicators.

Use other liquid fumigant mixtures as labeled.

Aluminum phosphide. Tablets may be added to grain as it is binned, or probed into binned grain.

Type of storage	Grain temperature	Dosage (per 1,000 bu.)	
		Tablets	Pellets
Concrete or steel elevator tanks	54-59° F.	150	500
	60-68° F.	90	300
	over 68° F.	60	200
Round steel bins ("Butler" type)	54-59° F.	180	600
	60-68° F.	120	400
	over 68° F.	90	300

For average wooden farm bins use 180 tablets per 1,000 bu.

Read and follow all precautions listed on the labels for each different fumigant. Repeat fumigants may be necessary. Information about other fumigants is available from the Department of Entomology, Fisheries, and Wildlife, University of Minnesota.

Other publications in this series:

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Extension Folder 413—Insecticide Suggestions to Control Livestock and Poultry Pests.

Extension Folder 414—Insecticide Suggestions to Control Tree, Shrub, Lawn, and Turf Insects.

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