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1988 Weed Control Guide for Vegetable Crops



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1988 Weed Control Guide for Vegetable Crops

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Other Extension Publications with Information on Weed Control

These publications are available from your county Cooperative Extension Service office, or from the MSU Bulletin Office, P.O. Box 6640, East Lansing, MI 48826-6640. Prices are subject to change due to revisions. Contact your county office for current prices.

E-154	Fruit Pesticide Handbook For Sale Only	E-1215	A Quick Test for Atrazine Carryover Single copy free to Michigan residents.	E-1858	Using Spray Additives with Herbicides For Sale Only
E-434	Weed Control Guide for Field Crops For Sale Only	E-1296	Herbicide-Fertilizer Combinations Single copy free to Michigan residents.	NCR-158	Herbicide Symptoms in Dry Edible Beans Single copy free to Michigan residents.
E-653	Lawn Weed Control Guide Single copy free to Michigan residents.	E-1363	Guide to the Identification of Common Weed Seedlings of Michigan For Sale Only	NCR-164	Nightshade Control in Field Crops Single copy free to Michigan residents.
E-791	Problem Perennial Weeds in Michigan For Sale Only	E-1517	Poison Ivy Control Single copy free to Michigan residents.	NCR-281	Weeds of the North Central States For Sale Only



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Basic Principles of Weed Control with Herbicides

Weeds reduce crop yields by competing with crops for water, nutrients, and light. Some weeds release toxins that inhibit crop growth, and others may harbor insects, diseases, or nematodes that attack crops. Weeds often interfere with harvesting operations, and sometimes contamination with weed seeds or other plant parts may render a crop unfit for market. Profitable crop production depends on effective weed control.

An effective weed control program includes environmentally sound cultural, mechanical, and chemical weed-control methods. The increasing concern with pesticide residues in the environment, food, and groundwater make it especially important that growers use herbicides as efficiently as possible. Crop rotation, cultivation, use of cover and companion crops, and use of different herbicides avoids build-up of resistant weeds and pesticide residues in the soil.

Safe Use of Pesticides

Herbicides may be grouped in several different classification systems:

- selective vs. non-selective
- contact vs. translocated
- preplant incorporated vs. preemergence vs. postemergence
- soil incorporated vs. soil surface applied vs. foliar applied
- type of activity within the plant
- chemical family

By knowing and understanding these various classifications, it is possible to develop an effective chemical weed control program for most crops, using minimal herbicide while obtaining good weed control.

Selection of Herbicides

Select and purchase herbicides that are labeled and effective for the crop and weed problems on your farm. Read the label before purchasing to make sure the pesticide meets your needs. Be sure it is effective on your soil type and against your weed pests.

Pay particular attention to the *Environmental Hazards* block of all pesticide labels. Under the Endangered Species Act, all pesticide labels are required to indicate whether or not a particular product

is prohibited from use in certain states or counties. If your farm lies within a habitat range of an endangered species, you will be prohibited from using certain pesticides. Check the label for these new label restrictions before you purchase a pesticide.

Groundwater Preservation

Residues of some pesticides, because of their characteristics and the amount used, may be found in surface or groundwater. Several chemical characteristics, including solubility in water, rate of degradation, volatility, and tendency for fixation on soil particles or organic matter will have an effect on the amount of pesticide appearing in groundwater. Physical characteristics of the site, including soil type, soil depth, water table depth, slope, and weather also have an effect on the appearance of pesticides in groundwater. Growers should be aware of all the factors involved and make every effort to avoid contamination of surface or subsurface water.

Pesticide Emergency Preparedness

When purchasing a pesticide, obtain a specimen label from the dealer and keep it on file on the farm. This label will be available immediately if an emergency involving a pesticide occurs. Take the specimen label along to a medical treatment center if an individual has suffered pesticide poisoning.

Read and observe closely the *Precautionary Statements* section of the label. Make sure that several people are aware of and can administer treatments for pesticide poisoning contained in the *Statement of Practical Treatment* on the label.

Transporting Pesticides

Have pesticides delivered directly to your pesticide storage facility to avoid liability and potential accidents and spills in transit.

Storage of Pesticides

Pesticides must be stored in a facility that will protect them from temperature extremes, high humid-

ity, and direct sunlight. The storage facility should be heated, dry, well ventilated, and designed for easily handling pesticide material. The storage facility should be designed and built with materials that meet federal and state codes and regulations for the storage of flammable and combustible materials. Store only pesticides in such a facility and always store pesticides in their original containers.

Do not store any feed, seed, food, or fertilizer with pesticides. Do not store protective clothing or safety equipment in the pesticide storage facility. Store herbicides separately from other types of pesticides to avoid contamination of one material by another.

Keep the facility locked at all times when not in use to prevent animals, children, and irresponsible adults from entering and becoming poisoned. Post the facility as a *Pesticide Storage Facility* to warn others that the area is off limits. Maintain an accurate inventory of the pesticides stored in the facility at all times in case of emergency.

Always read and follow the *Storage and Disposal* section of pesticide labels for specific storage and handling instructions.

Handling and Mixing of Pesticides

Always wear protective clothing and equipment when handling, mixing, and applying pesticides and during cleanup of application equipment. Protective equipment should include full coverage clothing (heavy gauged rubber slicker or TYVEK suit), chemical resistant gloves and boots, goggles, hard hat, and a MSHA/NIOSH-approved respirator or air purifier with a chemical absorbent or filtering material appropriate for the pesticide being used. Take care of all protective equipment as if your life depends on it.

Mix pesticides standing upwind and keep the pesticide container below shoulder level. Avoid excessive splashing with liquids and dust clouds with solid materials. If pesticides are spilled on you, wash them off immediately with lots of soap and water and change your clothing. Resume the operation only after

cleaning up any spilled pesticide. Use closed handling and mixing systems when appropriate.

Mix only the amount of pesticides required for the area to be treated. Keep unauthorized persons out of the area in which you handle pesticides.

Handling and Disposing of Pesticide Containers

All pesticide containers are considered HAZARDOUS WASTE unless they are triple rinsed. Use the rinsate as additional dilution in the spray mixture. After triple rinsing empty pesticide containers, puncture both ends so that the containers cannot be reused. Metal and plastic containers can be offered for recycling. If recycling is not available, dispose of them in a state licensed sanitary landfill. Dispose of all paper containers in a sanitary landfill or municipal waste incinerator. Do not bury or burn any pesticide containers. Do not reuse empty pesticide containers for any purpose.

Cleaning of Pesticide Application Equipment

Follow all specific label directions for cleaning application equipment. It is important to clean weed control sprayers after use, especially if they are used for more than one crop and for application of insecticides and fungicides. The need for extensive cleaning can be minimized if one sprayer is dedicated to herbicide application only.

Do not use a sprayer to apply insecticides or fungicides if the sprayer has been used to apply 2,4-D type herbicides.

When cleaning a sprayer used only for herbicide application, only water rinsing is necessary. Rinse the whole sprayer with water, inside and out, including boom, hoses, and nozzles. Partially fill the spray tank with water and keep the pump running so that the water is circulated throughout the entire system. Spray the water through the nozzles. Apply the rinsate to cropland according to recommended rates. Repeat the process when changing herbicides and at the end of each day.

Clean sprayers completely when changing from herbicides to other pesticides. Add 1 gallon of ammonia to 100 gallons of water. Pump it through the system. Leave the cleaning solution in the sprayer system for at least two hours and then pump it out through the nozzles. Do not apply the washing solution to crops. Rinse the system with water after draining the rinsate. Do not leave pesticide solution or cleaning solution in the tank overnight.

Unused and Unwanted Pesticides

Pesticides that for some reason cannot be used on a crop must be disposed of as hazardous waste. To avoid the difficulty and expense of hazardous waste disposal, use your pesticides on labeled crops. If you have to dispose of some pesticides, contact the Michigan Department of Natural Resources, Hazardous Waste Management Division, for instructions on disposal.

Application of Pesticides

Prior to any application, the equipment used must be thoroughly checked for sound operation and accurately calibrated. Poor maintenance and calibration practices lead to excessive residues on the crop and could harm humans, animals, crops, and the environment. Inspect and calibrate the application equipment frequently. Also, inspect the equipment during use to prevent the unintentional misapplication of chemicals. If equipment needs repair, stop spraying and fix the problem immediately.

Do not spray when the wind is greater than 10 miles per hour and/or weather conditions (e.g., inversions) are conducive to pesticide drift away from the target area. Make every effort to AVOID PESTICIDE DRIFT!

Warn all unauthorized persons to leave a target area being treated with a pesticide. This is the responsibility of both the applicator and grower. Warn occupants of properties near the target area when such precautions are specified by a pesticide label or when common sense dictates a written or verbal warning.

Re-entry into the Treated Area

Read and follow the label instructions on re-entry for each pesticide used. Post areas that have been treated to warn others not to enter until the specified re-entry time has elapsed. Posted signs should be as legible as a highway speed limit sign. Take down the postings when the re-entry time is over. Any person who has to go into a treated area prior to the elapse of the re-entry period must wear protective clothing and equipment. Farm workers should not work in any treated area until the re-entry time has elapsed.

Plan to conduct a farm worker RIGHT-TO-KNOW training program for all your employees. Use this training time to improve and maintain quality safety procedures for using agricultural chemicals on your farm. Contact your county Cooperative Extension Service agent to assist you in setting up a right-to-know employee training program on farm chemicals.

Spraying Equipment

A weed control sprayer should be made of non-corrosive materials, easy to clean, and have the following features.

1. A tank with a volume of 100 to 300 gallons to reduce filling and mixing operations.
2. A pump with a capacity of at least 10 gallons per minute and pressure up to 100 pounds per square inch (PSI).
3. An agitation system — The bypass from the pressure control is a good source of agitation. Direct the agitation line into the bottom of the tank. Make sure there is always some agitation in the tank.
4. Screens — There should be 50 mesh screens in the intake line and at each nozzle.
5. Pressure gauge — A pressure gauge calibrated to 100 psi should be mounted on the boom as near to the nozzles as possible.
6. Boom — The boom should be adjustable from 18 to 36 inches above the ground. It should be built so that it contains shock absorbers to keep the boom level when going over rough ground.

7. **Nozzles** — Flat fan nozzles with 73 to 95° angles are best suited for most weed control work. Nozzle volume can vary from 1 to 10 gallons per minute, depending on the application; 8002 or 8004 are good general-use nozzles.

Sprayer Calibration

One of the most important factors in effective weed control is accurate calibration of the equipment. The following steps can be used as a guide to calibrate a ground sprayer.

1. **Determine** the desired application volume of carrier (usually water) in gallons per acre (GPA). Ten to 30 GPA at 30 to 40 PSI is sufficient for most weed control applications.

2. **Adjust** the boom height so that the spray overlaps about 30 percent at the ground (or other surface to be sprayed). With 80° nozzles, this places the nozzles about 20 inches apart on the boom and 20 inches above the sprayed surface. Check each nozzle at the recommended pressure for output. Replace any defective nozzles and screens.

3. **Fill** the spray tank and system with water.

4. **Spray** a measurable area in the field, at a fixed speed and at the desired pressure. Spray at least 20% of the total tank volume and at least 2 acres of area.

5. **Measure** the volume of water (in gallons) needed to refill the tank.

6. **Determine** the area (in acres) that was test sprayed using the following formula: length of area sprayed (in feet) X boom width (in feet) ÷ 43,560 = acres sprayed.

7. **Divide** the volume sprayed by the area sprayed to obtain the actual output of the sprayer in gallons per acre.

8. **Make adjustments** to tractor speed, pressure, or nozzle size and repeat steps 3 to 7 to change application rate.

9. **Calculate** the amount of formulated pesticide needed to treat the desired area.

Band application — The expense of herbicide application can be reduced by spraying bands over the crop rows rather than the whole field (broadcast application). When spraying in bands, adjust the amount of herbicide for the area actually

sprayed, rather than the total acreage. The amount of chemical per gallon of carrier will remain the same. Use even spray nozzles (e.g., 8004E) rather than tapered spray nozzles (e.g., 8004) for band applications.

Pesticide Registration

Pesticides must be registered with the U.S. Environmental Protection Agency and the Michigan Department of Agriculture before they can be used legally in Michigan. This bulletin suggests using pesticides to manage pests. Purchase only those pesticide products that are labeled for the crop you wish to use it on and the pest you wish to control. Remember that the pesticide label is a legal document on pesticide use. Read the label carefully and closely follow all instructions and limitations. The use of a pesticide in a manner not consistent with the label can lead to injury of crops, humans, animals, and the environment, and also can lead to civil fines and/or condemnation of the crop. Pesticides are good management tools to control pests, but only when they are used in an effective, economical, and environmentally sound manner.

Key to Abbreviations in this publication

ae=acid equivalent

ai=active ingredient

DF=dry flowable

DS=dry soluble

E or **EC**=emulsifiable concentrate

ES=emulsifiable solution

F or **FL**=flowable

G=granule

L=liquid

S or **SP**=soluble powder

W or **WP**=wetable powder

WEED CONTROL RECOMMENDATIONS FOR VEGETABLE CROPS

Crop	Weed Problem	Chemical	Pounds Active Ingredient (AI)/Acre	Amount of Commercial Formulation/Acre	Remarks and Limitations
ASPARAGUS (Seedlings or newly planted crowns)	Germinating or emerged annuals	linuron (LOROX 4L)	1/2 - 1 1/2	1/2 - 1 1/2 qt	Apply before emergence and after fern is 6 inches high. Plant seed at least 1 inch deep; use 1 lb rate postemergence. Do not exceed 2 lb ai/acre/year. Does not control crabgrass postemergence. Pre-emergence weed control will be reduced in soils with organic matter greater than 5%.
	Germinating annuals	chloramben (AMIBEN 75DS)	2 - 3	2 1/2 - 4 lb	Apply before asparagus and weeds emerge. Use lowest rate on sandy soils. If soil is dry, irrigate after application.
ASPARAGUS (Seedlings)		terbacil (SINBAR 80WP)	0.8 - 1.6	1 - 2 lb	Spray 300 lb/acre activated charcoal in a 1 inch band over rows at planting. Then apply Sinbar. One-half inch moisture within 2 weeks of application will improve control. Do not use on soils with less than 1% organic matter. Do not plant any crop other than asparagus within 2 years of application. Use lowest rate on sand and sandy loam soils.
	Emerged annuals	paraquat (GRAMOXONE SUPER) (1.5 lb/gal)	1/2	1 1/2 qt	Apply after weeds emerge, but before asparagus emerges. For maximum knockdown, add a surfactant at 1 qt/100 gal of spray solution.
ASPARAGUS (Established one year or more)	Germinating annuals	diuron (KARMEX 80WP)	2 - 3	2 1/2 - 4 lb	Apply after tillage or chopping fern in the spring and again after the harvest season, if necessary. Apply before weeds emerge. Total dosage should not exceed 4.8 lb ai/acre/year. 6-8 weeks residual activity.
	Germinating grasses	simazine (PRINCEP 80WP)	2 - 4	2 1/2 - 5 lb	Apply after tillage or chopping fern in the spring and again after the harvest season, if necessary. Apply before weeds emerge. Total dosage should not exceed 4 lb ai/acre/year. 6-8 weeks residual activity.
ASPARAGUS (Established one year or more)	Germinating annuals	napropamide (DEVRIROL 50WP)	4	8 lb	Apply after emergence in the spring and incorporate 1 to 2 inches. Gives good grass control. 4-6 weeks residual activity.
	Germinating annuals	trifluralin (TREFLAN 4EC)	1 - 1 1/2	1 - 1 1/2 qt	Use higher rate on heavier soils. Apply and incorporate 1-2 inches early in the spring when spears are at least 4 inches below the soil surface. Gives good grass control. 4-6 weeks residual activity.
ASPARAGUS (Established one year or more)	Germinating or emerged annuals	linuron (LOROX 4L)	1/2 - 2	1/2 - 2 qt	Apply before or after crop emergence. Use high rate pre-emergence. Make 1 to 4 applications of 1/2 to 1 lb ai/acre post-emergence. Do not apply within 1 day of harvest. Do not exceed 4 lb ai/acre/year. Does not control crabgrass postemergence. Pre-emergence control will be reduced in soils with organic matter greater than 5%. 4 weeks residual activity.

Germinating annuals, Sandbur	metribuzin (SENCOR 4F, LEXONE 4L)	1 - 2	1 - 2 qt	Apply after tillage or chopping fern in the spring and again after the harvest season, if necessary. Apply before weeds emerge. Total dosage may not exceed 2 lb ai/acre/year. Two applications are necessary for good season-long sandbur control. 6-8 weeks residual activity.
Germinating annuals, quackgrass	terbacil (SINBAR 80WP)	1.2 - 2.4	1½ - 3 lb	Apply prior to spear emergence or after a clean cutting. Do not use on soils with less than 1% organic matter. Do not apply to diseased plants. Do not apply more than 2.4 lb ai/acre/year. Do not apply more than 2 applications per year. Do not plant to any crop other than asparagus within 2 years of application. Use lowest rate on sandy and sandy-loam soils. 8-12 weeks residual activity.
Emerged annuals	paraquat (GRAMOXONE SUPER) (1.5 lb/gal)	½ - 1	1½ - 2½ qt	Apply before crop emergence or after the last harvest. Include a non-ionic surfactant. 6 day harvest restriction.
Quackgrass	glyphosate (ROUNDUP) (3 lb/gal)	1½	2 qt	Apply immediately after the last harvest when all spears are snapped off. Do not let herbicide contact fern. Roundup is most effective when applied to actively growing quackgrass just before seed stalks appear.
Emerged perennials, mareetail, volunteer asparagus	glyphosate (ROUNDUP) (3 lb/gal)	1½ - 3	2 - 4 qt	Apply immediately after the last harvest when all spears are snapped off. Do not let herbicide contact emerged spears or fern. Include ½ qt non-ionic surfactant per acre. Spot spray weeds that escape first application.
	2,4-D amine salts (several)	2		Apply before, during, or after the harvest season when weeds are growing rapidly. During the harvest season, spray immediately after a harvest to minimize injury to asparagus. When spraying after the harvest season, use drop nozzles to avoid spraying fern.
BEANS (snap, lima)	paraquat (GRAMOXONE SUPER) (1.5 lb/gal)	½ - 1	1½ - 2½ qt	Apply before or after seeding but before crop emergence. Include a non-ionic surfactant.
Quackgrass	glyphosate (ROUNDUP) (3 lb/gal)	1½	2 qt	Apply to 8- to 10-inch tall quackgrass in the fall or spring prior to planting. Allow at least 5 days before plowing.
Germinating broadleaves and some grasses	chloramben (AMIBEN 75DS)	2 - 2½	2½ - 3 lb	Apply before emergence. If possible, apply when soil is moist. Use high rate on heavy, high-organic matter soils for black nightshade control. Do not use on very light, sandy soils.
Germinating grasses and some broadleaves	EPTC (EPTAM 7E)	3	2 qt	Apply before planting. Incorporate 2-4 inches into soil immediately after spraying. Gives good nutsedge, quackgrass, and annual grass suppression. Do not use on lima beans.
	pendimethalin (PROWL 4EC)	1 - 1½	1 - 1½ qt	Apply before planting and incorporate 1-2 inches deep. Use high rate on soils with 3% organic matter or more.
	metolachlor (DUAL 8E)	1½ - 3	¾ - 1½ qt	Use lower rate on sandy soils with less than 3% organic matter. Incorporate 1 to 2 inches before planting, or apply preemergence after planting.
	trifluralin (TREFLAN 4EC)	½ - ¾	½ - ¾ qt	Apply before planting. Incorporate into soil 2 to 3 inches soon after spraying. Use lowest rate on sandy soils. Does not control ragweed.

Crop	Weed Problem	Chemical	Pounds Active Ingredient (AI)/Acre	Amount of Commercial Formulation/Acre	Remarks and Limitations
BEETS (Red)	Emerged annuals, yellow nutsedge, Canada thistle	bentazon (BASAGRAN) (4 lb/gal)	¾ - 1	¾ - 1 qt	Apply after beans have more than 1 expanded trifoliolate leaf to prevent crop injury. Two applications are needed for nutsedge and Canada thistle control. Do not apply more than 2 lb ai/acre/year.
	Germinating and emerged annuals	pyrazon (PYRAMIN RB 75WP)	3 - 4	4 - 5 lb	Apply from planting up until weeds are 1 inch high. On muck soils, better control is obtained by spraying small weeds after beets have two true leaves. Add crop oil at 1 gal/40 gal of spray or a surfactant, such as X-77 at 1 pt/50 gal of spray.
	Germinating annuals	cycloate (RO-NEET 6E)	3 - 4	2 - 3 qt	Apply before planting. Incorporate 2-3 inches after spraying. Use lowest rate on sandy soils. Not effective on muck soils.
Emerged broadleaves		diethyl-ethyl (ANTOR 4ES)	3 - 6	3 - 6 qt	Apply and incorporate 1-2 inches before seeding, or apply pre-emergence after seeding to moist soil. Needs rain or irrigation for activation. Use only on beets for processing.
		phenmedipham (SPIN-AID 1.3 EC)	1	3 qt	Apply after beets have 4 true leaves. Use no more than 22 gal spray solution per acre. Do not apply if beets are under any type of stress. CHECK LABEL FOR WEEDS CONTROLLED AND PRECAUTIONS. Does not control redroot pigweed. 60 day harvest restriction.
BROCCOLI, BRUSSELS SPROUTS, CABBAGE, CAULIFLOWER (Seeded or transplanted)	Perennials	glyphosate (ROUNDUP) (3 lb/gal)	1½ - 2	2 - 3 qt	Apply to emerged perennials before planting in the spring or after harvest in the fall. Check label for best time of year, stage of growth, and rate for each problem perennial weed.
	Emerged annuals	paraquat (GRAMOXONE SUPER) (1.5 lb/gal)	½ - 1	1½ - 2½ qt	Apply before transplanting or before or after seeding, but before crop emergence. Include a non-ionic surfactant.
	Germinating grasses and broadleaves	trifluralin (TREFLAN 4EC)	½ - ¾	½ - ¾ qt	Apply before seeding or transplanting. Incorporate 2-3 inches soon after spraying. Use lowest rate on sandy soils and highest rate on soils high in clay or organic matter. Not effective on muck soils.
CARROTS	Perennials	napropamide (DEVIRINOL 50WP)	1 - 2	2 - 4 lb	Apply before seeding or transplanting and incorporate 1-2 inches. May be applied after planting. Irrigate within 24 hours and soak soil 2-4 inches.
	Germinating and emerged annuals	DCPA (DACTHAL 75WP)	8 - 10	10 - 13 lb	Apply after seeding or transplanting but before weeds germinate. Not effective on muck soils.
CARROTS	Perennials	glyphosate (ROUNDUP) (3 lb/gal)	1½ - 2	2 - 3 qt	Apply to emerged perennials before planting in the spring or after harvest in the fall. Check label for best time of year, stage of growth, and rate for each problem perennial weed.
	Germinating and emerged annuals	linuron (LOROX 4L)	½ - 1½	½ - 1½ qt	Apply before emergence and after carrots are 3-4 inches tall. Use higher rate on weeds more than 2 inches tall. Do not apply over carrots when temperature exceeds 85° F and do not apply at pressures greater than 40 psi. Do not mix with other pesticides or wetting agents. Do not apply within 2 days of an application of stoddard solvent. Do not exceed 2 lb ai/acre/year.

Germinating annuals	chlorpropham (FURLOE-CHLORO IPC 4E)	4	4 qt	Apply before weeds emerge. Provides weed control for 3-4 weeks on muck soil. Extremely effective on chickweed, smartweed, and field dodder.
Emerged grasses	fluazifop-p (FUSILADE 2000 1E)	0.16 - 0.19	1 1/4 - 1 1/2 pt	Apply to actively growing grasses. Do not apply more than 6 pt/acre/year. Include crop oil concentrate (1% by volume) or nonionic surfactant (0.25% by volume) in the spray solution. 45 day preharvest interval.
Perennials	glyphosate (ROUNDUP)	1 1/2 - 2	2 - 3 qt	Apply to emerged perennials before planting in the spring or after harvest in the fall. Check label for best time of year, stage of growth, and rate for each problem perennial weed.
Germinating grasses and some broadleaves	trifluralin (TREFLAN 4EC)	1/2 - 1	1/2 - 1 qt	Mineral soil only. Apply before planting and incorporate 2-3 inches soon after spraying. Use low rate on sandy soils. Does not control ragweed.
CELERY (Transplanted)	prometryn (CAPAROL 4L)	1 - 2	1 - 2 qt	Make 1 application 2-6 weeks after transplanting but before weeds are 2 inches tall. Do not exceed 2 lb ai/acre/year.
	linuron (LOROX 4L)	1	1 qt	Apply after transplanting but before weeds are 2 inches tall. Do not exceed 40 psi pressure. Do not apply when temperatures exceed 85° F and do not mix with wetting agents or other pesticides.
Perennials	glyphosate (ROUNDUP) (3 lb/gal)	1 1/2 - 2	2 - 3 qt	Apply to emerged perennials before planting in the spring or after harvest in the fall. Check label for best time of year, stage of growth, and rate for each problem perennial weed.
CUCUMBERS (seeded)	paraquat (GRAMOXONE SUPER) (1.5 lb/gal)	1/2 - 1	1 1/2 - 2 1/2 qt	Apply before or after seeding but before crop emergence. Include a non-ionic surfactant.
	naptalam (ALANAP) (2 lb/gal) plus bensulide (PREFAR 4E)	3 - 4 plus 4 - 6	6 - 8 qt plus 4 - 6 qt	Apply after planting or in a split application. With irrigation, apply the two chemicals in a tank mix and irrigate immediately. With no irrigation, apply bensulide prior to planting and incorporate 2-3 inches. Apply naptalam to surface after planting. Use the lowest rates on sandy soils. A second application of naptalam may be made a month after planting before cucumbers vine out. It will extend pre-emergence control and give some postemergence control of emerged broadleaves.
Germinating nightshade, ragweed, smartweed	chloramben (AMIBEN 75DS)	2 - 3	2 1/2 - 3 1/2 lb	Use only with a vermiculite anticrustant and activated carbon seed protection system. After seeding with the anticrustant, broadcast chloramben in 10 - 40 gal water per acre. Some weeds will germinate in the row.
CUCUMBERS (Transplanted)	naptalam (ALANAP) (2 lb/gal)	4	8 qt	Apply before or after transplanting but before weeds emerge. Irrigate after application if soil is dry. Apply with bensulide before planting when grasses are a problem.
	bensulide (PREFAR 4E)	6	6 qt	Apply before transplanting. Irrigate or incorporate into top 2 inches of soil.
EGGPLANT	DCPA (DACTHAL 75WP)	8	11 lb	Apply after transplanting but before weeds emerge.
	napropamide (DEVRIINOL 50WP)	1 - 2	2 - 4 lb	Apply before transplanting. Incorporate 1-2 inches. Use lower rate on coarse, sandy soils and higher rate on heavy, clay soils. Carry-over the following year may affect sensitive crops, especially small grains.

Crop	Weed Problem	Chemical	Pounds Active Ingredient (AI)/Acre	Amount of Commercial Formulation/Acre	Remarks and Limitations
ENDIVE, ESCAROLE	Germinating annuals, quack-grass	pronamide (KERB 50WP)	1 - 1½	2 - 3 lb	Apply before or after seeding and before weeds emerge. Must be incorporated or irrigated into soil. Can be applied post-emergence to crop. Weed control will be marginal on muck soil.
	Germinating annuals	DCPA (DACTHAL 75WP)	8 - 10	11 - 13 lb	Apply after seeding but before weeds emerge. Not effective on muck soils.
HORSERADISH	Perennials	glyphosate (ROUNDUP) (3 lb/gal)	1½ - 2	2 - 3 qt	Apply to emerged perennials before planting in the spring or after harvest in the fall. Check label for best time of year, stage of growth, and rate for each problem perennial weed.
	Germinating annuals, quack-grass	pronamide (KERB 50WP)	1 - 2	2 - 4 lb	Apply before or after seeding but before weeds emerge. Must be incorporated or irrigated into soil. Can be applied post-emergence. Use high rate on muck soils; weed control will be marginal.
	Germinating annuals, especially grasses	benefin (BALAN 1.5LC)	1 - 1½	3 - 4 qt	Apply before planting. Incorporate 2-3 inches immediately after spraying. Not effective on muck soils.
LETTUCE	Perennials	glyphosate (ROUNDUP) (3 lb/gal)	1½ - 2	2 - 3 qt	Apply to emerged perennials before planting in the spring or after harvest in the fall. Check label for best time of year, stage of growth, and rate for each problem perennial weed.
	Germinating annuals	terbacil (SINBAR 80WP)	0.4 - 0.8	½ - 1 lb	Apply in the spring before mint and weeds emerge. Use the lower rate postemergence or where carryover is a potential problem. Do not rotate to other crops within 2 years of application. Do not apply within 60 days of harvest.
MINT	Germinating broadleaves	oxyfluorfen (GOAL 1.6E)	½	2½ qt	Apply before mint emerges to avoid crop injury. May cause temporary stunting of mint.
	Emerged broadleaves	bentazon (BASAGRAN) (4 lb/gal)	1	1 qt	Apply postemergence when weeds are small. Include crop oil concentrate at 1 qt/acre. Do not exceed 4 lb/acre/year.
MUSKMELONS (Transplanted)	Emerged annuals	bromoxynil (BUCTRIL 2E) (BROMINAL ME4)	¼ ¼	1 pt ½ pt	Apply during dry weather with temperatures below 70° F. Effective on small weeds. May cause temporary stunting and leaf chlorosis of mint.
	Germinating broadleaves	paraquat (GRAMOXONE SUPER) (1.5 lb/gal)	½ - 1	1½ - 2½ qt	Apply before planting to kill emerged weeds. Include a non-ionic surfactant.
Germinating grasses	Germinating broadleaves	naptalam (ALANAP) (2 lb/gal)	4	8 qt	Apply before or after transplanting and before weeds emerge. If soil is dry, irrigate after application. When grasses are a problem, use with Prefar before planting.
	Germinating grasses	bensulide (PREFAR 4E)	6	6 qt	Apply before transplanting. Irrigate or incorporate 2-3 inches into soil immediately after spraying.

COLLARDS, KALE, MUSTARD, TURNIP GREENS	Germinating annuals	DCPA (DACTHAL 75WP)	8 - 10	11 - 13 lb	Apply after seeding but before weeds emerge. Not effective on muck soils.
		trifluralin (TREFLAN 4EC)	1/2 - 3/4	1/2 - 3/4 qt	Apply before planting. Incorporate 2-3 inches into soil soon after spraying. Use lowest rate on sandy soils. Not effective on muck soils.
OKRA (Seeded or transplanted)	Perennials	glyphosate (ROUNDUP) (3 lb/gal)	1 1/2 - 2	2 - 3 qt	Apply to emerged perennials before planting in the spring or after harvest in the fall. Check label for best time of year, stage of growth, and rate for each problem perennial weed.
	Germinating annuals	metolachlor (DUAL 8E)	1 1/2 - 3	3/4 - 1 1/2 qt	May be preplant incorporated or applied preemergence.
ONIONS (Seeded or sets)	Germinating annuals	trifluralin (TREFLAN 4EC)	1/2 - 1	1/2 - 1 qt	Apply and incorporate before planting.
		diphenamid (ENIDE 90W)	3 - 5	3 1/2 - 5 1/2 lb	Apply after seeding. Use higher rate on heavier soils. May reduce stands of fall seeded small grains.
	Emerged broadleaves	chlorpropham (FURLOE-CHLORO IPC 4E)	4	4 qt	Apply after planting until loop stage and again after 2 full true-leaf stage. Apply before or just as weeds emerge. Do not use on soils with less than 4% organic matter. Good on purslane, chickweed, smartweed. 30-day harvest restriction.
		oxyfluorfen (GOAL 1.6E)	1/32 - 1/16	2 1/2 - 5 fl oz	Apply as a broadcast spray in 20-40 gal water per acre. Apply after onions have at least 2 expanded true leaves. Spray during sunny, warm weather. Do not apply more than 1/2 lb ai (2 1/2 pt) total per acre per year. Do not apply after bulbing begins, or within 60 days of harvest.
ONIONS (Mineral soil)	Germinating annuals	bromoxynil (BROMINAL ME4)	1/4	8 fl oz	Gives good control of mustards, shepherdspurse, lambsquarter, and smartweed. Does not control purslane. Follow label precautions carefully to avoid crop injury.
	Perennials	glyphosate (ROUNDUP) (3 lb/gal)	1 1/2 - 2	2 - 3 qt	Apply to emerged perennials before planting in the spring or after harvest in the fall. Check label for best time of year, stage of growth, and rate for each problem perennial weed.
ONIONS (transplants)	Germinating annuals	DCPA (DACTHAL 75WP)	6 - 10	8 - 14 lb	Can be used on seed, sets, or transplants. Apply immediately after planting or after a clean cultivation. Use higher rate on heavier, darker soils.
GREEN ONIONS	Germinating annuals	oxyfluorfen (GOAL 1.6E)	0.3 - 0.5	3/4 - 1 1/4 qt	Apply within 2 days after transplanting. For post-emergence use, see seeded onions. Do not exceed a total of 1/2 lb/acre/year pre- and post-emergence.
PARSNIPS	Germinating annuals	DCPA (DACTHAL 75WP)	6 - 10	8 - 14 lb	Apply immediately after seeding or after a clean cultivation. Use higher rate on heavier soils.
	Germinating annuals	linuron (LOROX 4L)	1 - 2	1 - 2 qt	Apply before parsnips emerge and again after they are 4 inches tall. Apply when weeds are less than 2 inches tall. Do not apply when temperatures exceed 85° F. Do not apply at pressure greater than 40 psi. Do not apply within 2 days of stoddard solvent.

Crop	Weed Problem	Chemical	Pounds Active Ingredient (AI)/Acre	Amount of Commercial Formulation/Acre	Remarks and Limitations
PEAS	Quackgrass	glyphosate (ROUNDUP) (3 lb/gal)	1½	2 qt	Apply to 8-10 inch tall quackgrass in the fall or spring prior to planting. Allow at least 5 days before plowing.
	Germinating grasses and some broadleaves	trifluralin (TREFLAN 4EC)	½ – ¾	½ – ¾ qt	Apply before planting. Incorporate 2-3 inches soon after spraying. Use lower rate on early plantings on sandy soils.
		metolachlor (DUAL 8E)	1½ – 3	¾ – 1½ qt	Use lower rate on sandy soils with less than 3% organic matter. Apply preemergence only; do not incorporate.
		oryzalin (SURFLAN AS) (4 lb/gal) plus trifluralin (TREFLAN 4EC)	½ plus ½	½ qt plus ½ qt	Also suppresses common root rot (<i>Aphanomyces euteiches</i>). Follow normal TREFLAN procedures for soil incorporation. May be applied up to 2 weeks before planting.
	propachlor (RAMROD 4L)	3 – 4	3 – 4 qt	Apply before peas emerge. Use lower rate on sandy soils.	
PEAS (Southern)	Emerged annuals	paraquat (GRAMOXONE SUPER) (1.5 lb/gal)	½ – 1	1½ – 2½ qt	Apply before or after seeding but before crop emergence. Include a non-ionic surfactant.
	Canada thistle and emerged annuals	MCPB (CAN-TROL, THISTROL) (2 lb/gal)	½ – 1	1 – 2 qt	Apply when peas have developed 6-12 nodes. Do not apply later than 3 nodes before pea flowering or yields may be reduced. Do not apply when peas are under stress or when temperatures exceed 90° F.
	Emerged annuals, yellow nutsedge, Canada thistle	bentazon (BASAGRAN) (4 lb/gal)	¾ – 1	¾ – 1 qt	Apply after peas have 3 pairs of leaves to prevent injury. Two applications are needed for nutsedge and Canada thistle control. Do not apply more than 2 lb ai/acre/year.
		metolachlor (DUAL 8E)	1½ – 3	¾ – 1½ qt	Use lower rates on sandy soils with less than 3% organic matter. Incorporate 1-2 inches before planting, or apply preemergence after planting.
PEPPERS (Seeded)	Germinating annuals	trifluralin (TREFLAN 4EC)	½ – 1	½ – 1 qt	Apply before planting and incorporate 2-3 inches. Use lower rate on sandy soils.
		bentazon (BASAGRAN) (4 lb/gal)	¾ – 1	¾ – 1 qt	Apply after peas have 3 pairs of leaves to prevent injury. Two applications are needed for nutsedge and Canada thistle control. Do not apply more than 2 lb ai/acre/year.
		diphenamid (ENIDE 90W) napropamide (DEVIRINOL 50WP)	5 1 – 2	5½ lb 2 – 4 lb	Apply before peppers and weeds emerge. Irrigate after application if soil is dry. Apply before planting. Incorporate 1-2 inches. Use lower rate on coarse, sandy soils and higher rate on heavy, clay soils. Carryover the following year may affect sensitive crops.

PEPPERS (Transplanted)	Germinating annuals	diphenamid (ENIDE 90WP)	5	5½ lb	Apply after transplanting but before weeds emerge. Irrigate after application if soil is dry.
		napropamide (DEVIRINOL 50WP)	1-2	2-4 lb	Apply before planting. Incorporate 1-2 inches. Use lower rate on coarse, sandy soils and higher rate on heavy, clay soils. Carryover the following year may affect sensitive crops.
		trifluralin (TREFLAN 4EC)	½-1	½-1 qt	Apply before transplanting. Incorporate 2-3 inches soon after application. Use lower rate on sandy soils.
	Germinating broadleaves	chloramben (AMIBEN 10G)	2-4	20-40 lb	Apply 3 to 5 days after transplanting but before weed emergence, or later in the season after a cultivation. Use granular formulation only. Controls ragweed, smartweed, and nightshade. Use lowest rate on sandy soils.
POTATOES	Emerged quackgrass and other perennials	glyphosate (ROUNDUP) (3 lb/gal)	1½	2 qt	Apply to actively growing quackgrass at least 8 inches tall. Wait 3 days before plowing. Heavy stands of rye will reduce quackgrass control. Apply to other perennials as recommended on label.
	Germinating annual grasses and broadleaves	EPTC (EPTAM 7EC, GENEP 7EC)	4-6	2.3-3.5 qt	Incorporate 3 in. deep immediately after application. Use high rate for nutsedge and quackgrass suppression. Not effective on muck soil. Follow with delayed preemergence application of linuron or metribuzin.
		metolachlor (DUAL 8E)	2	1 qt	Apply soon after planting. Follow with a delayed preemergence application of linuron or metribuzin. May be applied to emerged potatoes to extend grass control. 40 day preharvest interval.
		pendimethalin (PROWL 4EC)	¾	¾ qt	Apply soon after planting. Do not use on muck soil. Follow with a delayed preemergence application of linuron or metribuzin.
		oryzalin (SURFLAN 4L)	¾	¾ qt	Apply soon after planting. Do not use oryzalin if corn is to be planted the next year using minimum or no tillage. Follow with delayed preemergence application of linuron or metribuzin.
Germinating and emerged broadleaves and grasses	linuron (LOROX 4L)	1	1 qt	Follow preemergence treatments listed above. Apply just before potatoes emerge but after weeds have emerged.	
	metribuzin (LEXONE 4L, SENCOR 4L)	½	½ qt	Follow preemergence treatments listed above. Apply just before potatoes emerge and after weeds have emerged. Do not use preemergence on Atlantic or Shepody varieties.	
Emerged broadleaves and grasses	metribuzin (LEXONE 4L, SENCOR 4L)	¼	8 fl oz	Apply postemergence over the top of potatoes. Avoid spraying during the 12-15 inch stage to avoid injury. Do not apply after 3 cool, cloudy days. Do not use on early maturing or red skin varieties. Do not apply within 1 day of other pesticides. Do not apply more than 1 lb ai/acre/year. Do not use on Atlantic, Shepody, Chip Belle, Bell Chip, or Centennial varieties.	
RHUBARB	Emerged annual weeds	paraquat (GRAMOXONE SUPER) (1.5 lb/gal)	½-1	1½-2½ qt	For use on dormant rhubarb, use higher rate for heavier weed infestation. Do not exceed 2 applications per season. Gives some suppression of quackgrass.
RUTABAGA, TURNIP	Germinating annuals	DCPA (DACTHAL 75WP)	8	11 lb	Apply before crop and weeds emerge. If soil is dry, irrigate lightly after application.

Crop	Weed Problem	Chemical	Pounds Active Ingredient (AI)/Acre	Amount of Commercial Formulation/Acre	Remarks and Limitations
SPINACH	Germinating annuals	diethyl-ethyl (ANTOR 4ES)	3-4	3-4 qt	Apply and incorporate 1-2 inches before seeding, or apply pre-emergence after seeding to moist soil. Needs rain or irrigation for activation.
	Germinating broadleaves	chlorpropham (FURLOE-CIPC 4E)	1-2	1-2 qt	Apply immediately after planting. Use lower rate when temperature is below 60° F.
SQUASH, PUMPKINS	Perennials	glyphosate (ROUNDUP) (3 lb/gal)	1½-2	2-3 qt	Apply to emerged perennials before planting in the spring or after harvest in the fall. Check label for best time of year, stage of growth, and rate for each problem perennial weed.
	Emerged annuals	paraquat (GRAMOXONE SUPER) (1.5 lb/gal)	½-1	1½-2½ qt	Apply before or after seeding but before crop emergence. Include a non-ionic surfactant.
STRAWBERRIES (New and established plantings)	Germinating annuals	chloramben (AMIBEN 75DS)	2	2½ lb	Apply before crop or weeds emerge. If soil is dry, irrigate after application.
	Germinating annuals	propachlor (RAMROD 4L)	4-6	4-6 qt	Apply after seeding but before weeds emerge. Use high rate on heavier soils. Use only on pumpkins for processing.
STRAWBERRIES (New and established plantings)	Germinating annuals	diphenamid (ENIDE 90W)	4-6	4½-6½ lb	Apply about 5 days after planting and before weeds emerge in spring or fall on established fields. Do not use on new plantings on sandy soil. Do not apply within 60 days of harvest. Controls seedling grains if applied prior to mulching.
	Germinating annuals	DCPA (DACTHAL 75WP)	6-8	8-11 lb	Apply about 5 days after planting but before weeds emerge in spring on established fields. Particularly effective on sandy soils. Do not apply after first bloom.
STRAWBERRIES (Established plantings)	Germinating and emerged broadleaves	napropamide (DEVRIINOL 50WP)	1-2	2-4 lb	Apply before weeds emerge in spring, or in fall or following cultivation. May inhibit runner rooting on extremely light, sandy soils. Must be irrigated in or incorporated 2 inches deep prior to planting.
	Emerged annuals	chloroxuron (TENORAN 50WP)	4	8 lb	Apply after transplanting but before weeds are 2 inches tall; apply in fall or spring on established fields. Do not apply within 60 days of harvest. Do not apply more than twice in a season.
STRAWBERRIES (Established plantings)	Emerged broadleaves	paraquat (GRAMOXONE SUPER) (1.5 lb/gal)	½	1½ qt	Apply as a directed spray, using shields to protect strawberry plants. Do not allow spray to contact strawberry plants. Do not apply within 21 days of harvest.
	Emerged and germinating annuals	2,4-D amine salts (several)	1	5-12 oz	Apply after harvest at renovation (after mowing). Do not apply after August 1 or misshapen fruit may be produced the next season.
STRAWBERRIES (Established plantings)	Emerged and germinating annuals	terbacil (SINBAR 80WP)	¼-⅝	5-12 oz	Apply at renovation (after mowing) or in late fall. Use the lowest rate on sandy soils. Do not use on the "Guardian" variety. Check the label for crops that can be planted after strawberries.

SWEET CORN	Germinating broadleaves	atrazine (80WP)	1	1¼ lb	Apply after planting but before weeds are 1 inch tall. Observe label warnings on crop rotations.
	Germinating annuals	atrazine (80WP) plus atachlor (LASSO 4EC)	1 plus 2	1¼ lb plus 2 qt	Apply before crop or weeds emerge. Observe label warnings on crop rotations.
		cyanazine (BLADEX 4L) plus atachlor (LASSO 4EC) or metolachlor (DUAL 8E)	0.6 - 2 plus 2 - 2½ or 1 - 2½	0.6 - 2 qt plus 2 - 2½ qt or ½ - 1¼ qt	Apply after planting but before weeds emerge. Use highest rates on soils with 4% or more organic matter. If used at correct rates, there should be no herbicide carryover the following year. Rainfall or irrigation (½ inch) after application will improve weed control.
		metolachlor (DUAL 8E)	1½ - 3	¾ - 1½ qt	Use lower rate on sandy soils with less than 3% organic matter. Incorporate 1-2 inches before planting, or apply preemergence after planting.
		atrazine + metolachlor (BICEP 6L)	1 - 1.9 or 1.3 - 2.5	1½ - 3 qt	Use high rate on clay and high organic soils. Observe label precautions on rotational crops.
	Emerged broadleaves	2,4-D amine salts	½		Spray after corn and weeds emerge but before corn is 8 inches tall. Avoid drift onto sensitive crops.
	Quackgrass	glyphosate (ROUNDUP) (3 lb/gal)	1½	2 qt	Apply to 8-inch quackgrass in the fall or spring before planting. Wait at least 5 days before plowing.
		EPTC (ERADICANE EXTRA 6E)	6	4 qt	Incorporate immediately after application. Do not use on soils with more than 10% organic matter. Suppresses emergence of quack grass and nutsedge.
	Nutsedge	butylate (SUTAN PLUS 6.7E)	4	2½ qt	Apply before planting. Incorporate 2-3 inches after spraying. Also controls annual grasses. Suppresses nutsedge for 3-4 weeks.
		EPTC (ERADICANE 6.7E)	4	2½ qt	Apply before planting. Incorporate 2-3 inches after spraying. Also controls annual grasses. Suppresses nutsedge for 3-4 weeks.
SWEET POTATOES	Nutsedge, Canada thistle, and other broadleaves	bentazon (BASAGRAN) (4 lb/gal)	¾ - 1	¾ - 1 qt	Treat nutsedge when 4-6 inches tall and again 10 days later. Apply to broadleaves when they are small and actively growing. Always add 1 qt crop oil concentrate per acre to the spray mix.
	Germinating grasses	diphenamid (ENIDE 90W)	5	5½ lb	Apply after transplanting, but before weeds emerge.
	Germinating broadleaves	chloramfen (AMIBEN 75DS)	3.6	5 lb	Apply immediately after transplanting.
	Perennials	glyphosate (ROUNDUP) (3 lb/gal)	1½ - 2	2 - 3 qt	Apply to emerged perennials before planting in the spring or after harvest in the fall. Check label for best time of year, stage of growth, and rate for each problem perennial weed.

Crop	Weed Problem	Chemical	Pounds Active Ingredient (AI)/Acre	Amount of Commercial Formulation/Acre	Remarks and Limitations
TOMATOES (Seeded)	Emerged annuals	paraquat (GRAMOXONE SUPER) (1.5 lb/gal)	1/2 - 1	1 1/2 - 2 1/2 qt	Apply before or after seeding but before crop emergence. Include a non-ionic surfactant.
	Germinating annuals	diphenamid (ENIDE 90W)	5	5 1/2 lb	Apply before tomatoes or weeds emerge. If soil is dry, irrigate after application.
	Germinating or emerged broadleaves	napropamide (DEVIRINOL 50WP)	1 - 2	2 - 4 lb	Apply before planting. Incorporate 1-2 inches. Use lower rate on coarse, sandy soils and higher rate on heavy, clay soils. Carryover may affect corn, small grains, alfalfa, lettuce, and sugar beets.
	Germinating or emerged broadleaves	metribuzin (SENCOR 4F, LEXONE 4L)	1/4	8 fl oz	Apply as a directed spray or broadcast after tomatoes have 5-6 leaves. Apply after 3 sunny, warm days. Do not apply within 1 day of application of other pesticides. Do not tank mix with other pesticides. Multiple applications can be made with a minimum of 14 days between applications. Up to 1 lb ai/acre can be applied as a directed spray. Avoid contact with tomato foliage. 7 days harvest restriction. Do not apply more than 1 lb ai/acre/year.
	Germinating nightshade, ragweed, smartweed	chloramben (AMIBEN 75DS)	2 - 3	2 1/2 - 4 lb	Use only with a vermiculite anticrustant and activated carbon seed protection system. After seeding with the anticrustant, broadcast chloramben in 10-40 gal water per acre. Some weeds will germinate in the row.
	Nutsedge	chloramben (AMIBEN 10G)	3 - 4	30 - 40 lb	Apply after the last cultivation to weed-free soil. Apply when tomato foliage is dry. Use granular formulation only.
		pebulate (TILLAM 6E)	4 - 6	2 2/3 - 4 qt	Apply as a directed spray to clean, cultivated soil and incorporate or irrigate.
TOMATOES (Transplanted)	Germinating annuals	napropamide (DEVIRINOL 50WP)	1 - 2	2 - 4 lb	Apply before planting. Incorporate 1-2 inches. Use lower rate on coarse, sandy soils and higher rate on heavy, clay soils. Carryover may affect corn, small grains, alfalfa, lettuce, and sugar beets.
		trifluralin (TREFLAN 4EC)	1/2 - 1	1/2 - 1 qt	Apply before transplanting. Incorporate 2-3 inches soon after application. Use lowest rate on sandy soils.
		diphenamid (ENIDE 90W)	4 - 6	4 1/2 - 6 1/2 lb	Apply after transplanting and before weeds emerge.
	Germinating broadleaves	metribuzin (LEXONE 4L, SENCOR 4L)	1/4 - 1/2	8 - 16 fl oz	Apply before transplanting and incorporate 2-4 inches. Usually used in combination with trifluralin.
	Germinating nightshade, ragweed, smartweed	chloramben (AMIBEN 10G)	3 - 4	30 - 40 lb	Apply 3 to 5 days after transplanting but before weed emergence, or later in the season after a cultivation. Use granular formulations only. Effective on ragweed, smartweed, and nightshade. Use lowest rate on sandy soils.
	Emerged broadleaves	metribuzin (LEXONE 4L, SENCOR 4L)	1/4	8 fl oz	Apply after transplants have started growing and before weeds are 2 inches tall. Repeat as necessary. Apply after 3 sunny, warm days. Do not apply within 1 day of application of other pesticides. Do not tank mix with other pesticides. Do not apply more than 1 lb ai/acre/year. Do not use hotcaps on treated plants within 7 days of application.

Nutsedge	pebulate (TILLAM 6E)	4 - 6	2 $\frac{2}{3}$ - 4 qt	Apply and incorporate to a depth of 2-3 inches before planting. Use lower rate on light colored soils with less than 2% organic matter.
WATERMELONS (Transplanted)	paraquat (GRAMOXONE SUPER) (1.5 lb/gal)	$\frac{1}{2}$ - 1	1 $\frac{1}{2}$ - 2 $\frac{1}{2}$ qt	Apply before planting to kill emerged weeds. Include a non-ionic surfactant.
Germinating broadleaves	naptalam (ALANAP) (2 lb/gal)	4	8 qt	Apply before or after transplanting but before weeds emerge. If soil is dry, irrigate after application. When grasses are a problem, use with Prefar before planting.
Germinating grasses	bensulide (PREFAR 4E)	6	6 qt	Apply before transplanting. Irrigate or incorporate 2-3 inches immediately after spraying.
NON-CROP LAND				
Bare ground-long term control of annual and perennial weeds	atrazine (80WP)	10 - 20	12 - 25 lb	For use around buildings, storage areas, fence rows, etc. Use higher rate for hard-to-control perennials. Addition of sodium chloride will improve control of field bindweed, goldenrod, and milkweed.
	diuron (80WP)	15 - 20	19 - 25 lb	Same as above.
	simazine (80WP)	10 - 20	12 - 25 lb	Same as above.
	hexazinone (VELPAR 90SP)	2 - 4 $\frac{1}{2}$	2 - 5 lb	Use higher rate on hard to kill weeds, clay soils, or soils containing more than 5% organic matter. Apply before or soon after weeds emerge. Will injure or kill woody perennials. Do not use around shade trees or ornamentals.
	bromacil (HYVAR X 80WP)	2 $\frac{1}{2}$ - 9	3 - 12 lb	Use lower rate for control of annuals, higher rate for control of perennials. Bromacil is quite soluble in water, and may move in runoff water to non-target areas. Therefore, do not use in or near turf, ornamentals, or other plants of value.
Cattails, quackgrass, other grasses	dalapon (DOWPON M 85% salt)	8 $\frac{1}{2}$ - 17	10 - 20 lb	Apply after flowers have formed.
Perennial broadleaves and grasses	glyphosate (ROUNDUP) (3 lb/gal)	1 $\frac{1}{2}$ - 3	2 - 4 qt	Apply to actively growing foliage. Check label for most susceptible stage of target weed. Include a non-ionic surfactant.
Emerged annuals	paraquat (GRAMOXONE SUPER) (1.5 lb/gal)	$\frac{1}{2}$	2 $\frac{1}{2}$ qt	Apply to actively growing foliage. Include a non-ionic surfactant. Can be used in combination with residual herbicides.
Annual broadleaves	2,4-D (several trade names and formulations)	1 $\frac{1}{2}$ - 3		Apply to actively growing foliage. Use amine or low-volatile ester formulations. Check label for amount of product per acre.

Crop	Weed Problem	Chemical	Pounds Active Ingredient (AI)/Acre	Amount of Commercial Formulation/Acre	Remarks and Limitations
	Annual and perennial broadleaves	dicamba (BANVEL) (4 lb./gal)	1/4 - 2	1/4 - 2 qt	Controls many annual and perennial herbaceous weeds. Check label for rate for specific weeds. Prevent drift to non-target areas.
	Brush control	dicamba (BANVEL) (4 lb./gal) plus 2,4-D			Apply 2-4 lb dicamba plus 4 lb 2,4-D amine or low-volatile ester in 100 gal water. Thoroughly wet leaves and branches of target brush. Brush is most easily controlled during late spring and early summer.
		triclopyr (GARLON) (4 lb./gal)	1 - 8	1 - 8 qt	Use higher rates for hard to kill tree and brush species. Thoroughly wet leaves and bark of brush. Do not exceed 40 psi pressure. Avoid contact with non-target species.
		fosamine (KRENITE) (4 lb./gal)	6 - 12	6 - 12 qt	Apply to brush in late summer or early fall. Response will be seen the following year. Thoroughly wet brush but do not spray to runoff. Apply in 50 to 300 gal/acre. Avoid contact with non-target plants.

Names, Sources, and Formulations of Herbicides Used on Vegetable Crops¹

Common Name	Trade Name ² and Manufacturer	Concentration and Commercial Formulations ³	Common Name	Trade Name ² and Manufacturer	Concentration and Commercial Formulations ³
alachlor	LASSO (Monsanto)	4 lb/gal L	hexazinone	VELPAR (DuPont)	90SP; 2 lb/gal L
atrazine	several	80WP; 4 lb/gal L	linuron	LOROX (DuPont)	50WP; 4 lb/gal L
benfenin	BALAN (Elanco)	1½ lb/gal L	MCPB	CAN-TROL (Rhône-Poulenc)	2 lb/gal L
bensulide	PREFAR (ICI)	4 lb/gal L	metolachlor	THISTROL (Rhône-Poulenc)	8 lb/gal L
bentazon	BASAGRAN (BASF)	4 lb/gal L	metribuzin	DUAL (Ciba-Geigy)	50WP; 75DF; 4L
bromacil	HYVAR X (DuPont)	80WP	napropamide	LEXONE (DuPont)	50WP; 75DF; 4L
bromoxynil	BROMINAL (Rhône-Poulenc)	4 lb/gal L	naptalam	SENCOR (Mobay)	50WP; 2 lb/gal L
butylate	BUCTRIL (Rhône-Poulenc)	2 lb/gal L	oryzalin	DEVIRINOL (ICI)	2 lb/gal L
chloramfen	SUTAN PLUS (ICI)	6.7 lb/gal L	oxyfluorfen	ALANAP (Uniroyal)	4 lb/gal L; 75WP
chloroxuron	GENATE PLUS (PPG)	2 lb/gal L; 10G	paraquat	SURFLAN (Elanco)	1.6 lb/gal L
chlorpropham	AMIBEN (Rhône-Poulenc)	50WP	pendimethalin	GOAL (Rohm and Haas)	4 lb/gal L
cyanazine	TENORAN (Ciba-Geigy)	4 lb/gal L	phenmedipham	GRAMOXONE SUPER (ICI)	1.3 lb/gal L
cycloate	FURLOE-CHLORO IPC (PPG)	80WP; 4L	prometryn	PROWL (Amer. Cyanamid)	80WP; 4 lb/gal L
DCPA	BLADEX (DuPont)	6 lb/gal L	pronamide	SPIN-AID (NOR-AM)	50WP
diethyl-ethyl	RO-NEET (ICI)	75WP	propachlor	CAPAROL (Ciba-Geigy)	4 lb/gal L
diphenamid	DACTHAL (Fermenta)	4 lb/gal L	pyrazon	KERB (Rohm & Haas)	75.5WP
diuron	ANTOR (NOR-AM)	90WP	sethoxydim	RAMROD (Monsanto)	1.53 lb/gal L
EPTC	ENIDE (NOR-AM)	80WP	simazine	PYRAMIN RB (BASF)	80WP
ethalfluralin	KARMEX (DuPont)	7 lb/gal L	stoddard solvent	POAST (BASF)	100% oil
fluzifop-p	EPTAM (ICI)	6.7 lb/gal L	terbacil	PRINCEP (Ciba-Geigy)	80WP
glyphosate	ERADICANE (ICI)	3 lb/gal L	trifluralin	several	4 lb/gal L
	GENEP (PPG)	1 lb/gal L	2,4-D amine salts	SINBAR (DuPont)	
	SONALAN (Elanco)	3 lb/gal L		TREFLAN (Elanco)	
	FUSILADE 2000 (ICI)	1 lb/gal L		several	
	ROUNDUP (Monsanto)	3 lb/gal L			

¹Trade names and formulations of herbicides are given for the convenience of the users. Other formulations of the same herbicides with the same active ingredients also may be labeled for use on certain crops.

²"several" means there are several trade names for the chemical. The mention of trade names does not imply that they are endorsed or recommended over those of similar nature not listed.

³ae — acid equivalent, ai — active ingredient, DF — dry flowable, DS — dry soluble, E or EC — emulsifiable concentrate, ES — emulsifiable solution, F or FL — flowable, G — granular, L — liquid, S or SP — soluble powder, W or WP — wettable powder.

Effectiveness of Herbicides on Weeds¹

Know Your Weed Species! — All herbicides have their strengths and weaknesses. Knowing what weeds are in your field will help you choose the most effective chemical among those registered for your crop.

HERBICIDE (TRADE NAMES)	REDROOT PIGWEED	COMMON LAMBSQUARTER	GALINSOGA	MUSTARDS	NIGHTSHADE	COMMON PURSLANE	COMMON RAGWEED	SMARTWEED	CRABGRASS	FOXTAILS	BARNYARD- GRASS	FALL PANICUM	STINKGRASS	QUACKGRASS	YELLOW NUTSEDGE
Pre-plant Incorporated Herbicides															
BALAN	G	F	P	P	P	G	P	P	E	E	E	E	E	P	P
DEVRIKOL	G	P	P	P	P	G	P	P	E	E	E	E	E	P	P
DUAL	G	F	G	P	G	F	P	F	E	E	E	E	E	P	F
EPTAM	G	G	F	F	F	P	F	F	E	E	E	E	E	G	G
PREFAR	G	P	P	P	P	P	P	P	E	E	E	E	E	P	P
RO-NEET	G	F	F	P	P	F	P	P	E	E	E	E	F	E	F
SUTAN PLUS	F	P	F	P	P	P	P	P	E	E	E	E	E	P	G
TILLAM	F	F	F	P	P	P	P	P	E	E	E	F	F	P	G
TREFLAN	G	F	P	P	P	F	P	P	E	E	E	E	E	P	P

Preemergence Surface-Applied Herbicides

AATREX	E	E	G	E	E	E	E	E	G	G	G	P	G	G	G
ALANAP	G	G	F	F	F	F	G	P	P	P	P	P	P	P	P
AMIBEN	E	E	F	F	G	G	G	F	F	F	F	P	F	P	P
ANTOR	G	F	G	F	G	F	P	F	G	G	G	G	P	P	P
BLADEX	F	E	G	G	E	E	E	G	G	G	F	G	P	P	P
CAPAROL	E	E	F	G	G	G	F	F	G	F	F	F	F	P	P
DACTHAL	F	F	P	P	P	P	P	P	E	E	E	G	E	P	P
DUAL	G	F	G	P	G	P	F	F	E	E	E	E	E	P	F
ENIDE	G	F	P	P	P	G	P	F	E	E	E	E	E	P	P
FURLOE	F	F	P	P	P	G	P	E	F	F	F	F	F	P	P
KARMEX	E	E	G	G	E	E	E	E	F	E	E	F	E	P	P
KERB	P	F	P	P	P	G	F	F	F	F	F	F	F	G	P
LASSO	E	F	G	P	G	G	F	F	E	E	E	E	E	P	F
LEXONE, SENCOR	G	E	E	E	P	E	E	F	G	G	G	P	P	P	P

¹Assuming that the chemicals are applied at the proper time and at the appropriate rate for each soil type. This information is based on performance of these chemicals in vegetable crops.

²Kill of top growth only.

E = Excellent, G = Good, F = Fair, P = Poor

HERBICIDE (TRADE NAMES)	REDROOT PIGWEED	COMMON LAMBSQUARTER	GALINSOGA	MUSTARDS	NIGHTSHADE	COMMON PURSLANE	COMMON RAGWEED	SMARTWEED	CRABGRASS	FOXTAILS	BARNYARD- GRASS	FALL PANICUM	STINKGRASS	QUACKGRASS	YELLOW NUTSEDGE
LOROX	E	E	G	G	G	E	E	G	F	E	G	F	E	P	P
PREMERGE	E	G	G	G	G	E	E	G	F	P	P	F	P	P	P
PRINCEP	E	E	G	E	E	E	E	E	F	E	E	F	E	F	P
PYRAMIN RB	G	F	P	G	G	G	G	G	F	F	F	F	F	P	P
RAMROD	G	F	G	P	G	G	F	F	E	E	E	E	E	P	P
SINBAR	G	G	G	G	G	G	G	G	G	G	G	G	G	F	P
SONALAN	G	G	P	F	F	G	P	G	E	E	E	E	E	P	P
SURFLAN	G	G	F	F	F	G	F	F	E	E	E	E	E	P	P

Herbicides with Postemergence Activity

AATREX	E	E	G	E	E	E	E	E	G	G	G	F	G	G	G
BASAGRAN	P	G	G	F	F	G	G	E	P	P	P	P	P	P	G
BLADEX	F	G	G	G	G	G	G	G	G	G	G	G	G	P	P
BROMINAL	F	E	G	G	P	G	E	P	P	P	P	P	P	P	P
CAPAROL	E	E	G	G	G	E	F	F	F	F	F	F	F	P	P
DOWPON	P	P	P	P	P	P	P	P	F	G	G	G	G	P	P
2,4D	E	E	G	E	E	E	E	P	P	P	P	P	P	P	P
GOAL	E	F	G	G	E	G	F	F	F	F	F	F	F	P	P
LEXONE, SENCOR	G	E	E	E	P	E	E	E	F	G	F	F	F	P	P
LOROX	E	E	G	G	G	E	E	P	P	F	F	P	P	P	P
PARAQUAT	E	E	G	E	E	E	E	E	E	E	E	E	E	E ²	E ²
ROUNDUP	E	E	E	E	E	E	E	E	E	E	E	E	E	E	F
SPIN-AID	P	G	G	G	F	G	G	P	P	P	P	P	P	P	P
STODDARD SOLVENT	E	E	F	E	E	E	P	E	E	E	E	E	E	F	F
TENORAN	E	G	G	E	G	F	F	F	F	F	F	F	F	P	P

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GENERAL PESTICIDE INFORMATION AND REFERRALS

County Cooperative Extension Service Office (____) ____-____

Integrated Pest Management Programs

Michigan State University
East Lansing, MI 48824 (517) 355-0117

Center for Environmental Toxicology

Michigan State University
East Lansing, MI 48824 (517) 353-6469

Pesticides and Plant Pest Management Division

Michigan Department of Agriculture
Lansing, MI 48909 (517) 373-1087

Office of Hazardous Waste Management

Michigan Department of Natural Resources
Lansing, MI 48909 (517) 373-2730

Center for Environmental Health Sciences

Michigan Department of Public Health
Lansing, MI 48909 (517) 335-8350

PESTICIDE EMERGENCY INFORMATION

Human Pesticide Poisoning

Eastern Half of Michigan

(within Detroit City proper)

(313) 745-5711

(within the 313 area code)

(800) 462-6642

(statewide)

(800) 572-1655

Poison Control Center
Children's Hospital of Michigan
3901 Beaubien
Detroit, MI 48201

Western Half of Michigan

(within Grand Rapids City proper)

(616) 774-7854

(within the 616 area code)

(800) 442-4571

(statewide)

(800) 632-2727

Blodgett Regional Poison Center
Blodgett Memorial Medical Center
1840 Wealthy, S.E.
Grand Rapids, MI 49506

Upper Peninsula

(within Marquette City proper)

(906) 225-3497

(Upper Peninsula only)

(800) 562-9781

U.P. Poison Control Center
Marquette General Hospital
420 West Magnetic Street
Marquette, MI 49855

Animal Pesticide Poisoning

Your Personal Veterinarian

(____) ____-____

and

Animal Health Diagnostic Laboratory

Michigan State University

East Lansing, MI 48824

(517) 353-1683

Pesticide Fire

Local Fire Department

(____) ____-____

and

Fire Marshal Division, Michigan State Police

(Local authorities will assist in contacting
the State Fire Marshall.)

Traffic Accident

Local Police Department, Sheriff's Office, or
State Police

(____) ____-____

and

Motor Carrier Division, Michigan State Police

(____) ____-____

Environment Pollution

Pollution Emergency Alerting System

Michigan Department of Natural Resources

3500 North Logan

Lansing, MI 48909

(800) 292-4706

Pesticide Use Incidence

Pesticides & Plant Pest Management Division

Michigan Department of Agriculture

(517) 373-1087