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WEED CONTROL GUIDE FOR VEGETABLE CROPS

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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 may interfere with harvesting operations, and in some instances, contamination with weed seeds or other plant parts may render a crop unfit for market. It is obvious that profitable crop production depends on effective weed control.

Some Basic Principles

You should never attempt to establish a vegetable crop in fields that are badly infested with perennial weeds such as quackgrass, yellow nutsedge, or Canada thistle. Herbicides and tillage should be used to control these pests at least one year in advance.

Usually, effective weed control in vegetable crops requires a combination of management techniques. You may need to use a combination of different herbicides or alternative methods. In some cases, minimizing tillage can effectively reduce weed populations. Growing the same crop year after year, using the same weed control techniques, will encourage the development of problem weeds. Rotation of crops, herbicide or tillage methods can help solve this problem. Whenever you see a small infestation of a problem perennial weed invading a field, it should be eradicated immediately. Wherever possible, weeds should be prevented from producing seed. One plant can produce thousands of seeds, and these seeds will live in the soil for many years.

Although herbicides offer an effective and economical means of weed control, certain risks are inherent in their use. Crop injury is one of these risks. No crop plant is completely resistant to herbicide injury, but is able to tolerate a certain dosage range. Selectivity, or the ability of a herbicide to kill weeds without harming plants, may be partially lost under favorable weather conditions. Careless application can also result in injury to your plants or those of a neighbor. Injury can range from complete destruction of plants to slight stunting or discoloration which often has no long-term adverse effect. More details on prevention and diagnosis of herbicide injury can be found in Extension Bulletin E-809, "Diagnosis and Prevention of Herbicide Injury" ($1.30).

Types of herbicides: — Many of the herbicides used in vegetable crops are chemicals that kill germinating weed seedlings in the soil. They may be applied and mixed into the soil prior to planting (pre-plant incorporated) or applied to the soil surface after planting and before crops or weeds emerge. As a group, these are called **pre-emergence herbicides.**

Surface moisture must follow surface treatment for most soil-applied herbicides to be effective; you will obtain best results when these herbicides are carried into the soil by rainfall or overhead irrigation. Rates of application vary with soil type. In general, lower rates are needed on sandy (coarse textured soils) than are needed on clays or mucks (fine textured soils).

Other herbicides are applied to the foliage of plants. As a group they may be called post-emergence herbicides. They may burn off the tops of weeds (**contact herbicides**) or they may be transported throughout the plants and kill the underground parts (**translocated or systemic herbicides**). The latter type of chemical is particularly useful for controlling perennial weeds. The performance of post-emergence herbicides is altered by the amount of water used per acre, wetting agents, and the size and vigor of the vegetation. Follow directions carefully to assure good weed kill with minimal crop injury.

Use Chemicals Safely

Herbicides, like all other pesticides, should be handled with extreme caution. There are two good reasons for using pesticides safely:

- To keep yourself and other people from being poisoned.
- To avoid harming the environment.

Many pesticide accidents have occurred when the operator was filling the spray tank. Although the greatest health hazard is considered to be ingestion of these chemicals by mouth, there is also danger of irritation to skin and eyes. Rubber gloves and goggles should be worn when handling herbicides. Avoid breathing vapors of these chemicals. Heed all handling precautions that are printed on the label.

Using more chemical than is recommended can produce a residue carryover in the soil. This could damage sensitive crops planted in the next season. Some chemicals that are used for control of perennial weeds will last more than one year in the soil. Be sure to keep this in mind when planning your crop rotations. The suggested chemicals in this bulletin should dissipate in one growing season unless otherwise specified. Check product labels for precautions on rotational crops.

Registration of Herbicides and Mixtures

Suggestions in this bulletin are based on field trials conducted in Michigan and other states over a period of several years. Use of these chemicals and methods requires registration of the products by the Environmental Protection Agency. Growers or commercial applicators should not use a chemical on a crop for which the compound is not registered; to do so could lead either to a **severe fine** for misuse or **confiscation of the crop** if excessive residues are found in that crop.

Do not mix herbicides with other herbicides or pesticides unless compatibility and safety have been demonstrated. Herbicide combinations suggested in this bulletin are either formulated together, registered for use as tank mixes, or have been used together for many years with good safety.

Weed Sprayers

Many types of sprayers are suitable for chemical weed control. You do not need to buy expensive, high-gallonage, high-pressure spray equipment. A complete weed-control sprayer should have the following features:

1. A low pressure pump. It should be easily replaced, not subject to damage by wettable powders, and have minimum capacity of 9 gallons per minute.

2. Solution agitation (stirring). It can be either mechanical or a bypass from the pump. If a power takeoff sprayer does not provide agitation, add a bypass to a galvanized tee between the pump and pressure gauge. To increase agitation in the tank, place an agitator nozzle on the end of the overflow hose. In this case, a separate valve on the bypass line will regulate pressure. If the pump does not have enough capacity for agitation under specific spraying conditions, provide it by using both the next lower tractor gear and nozzle tips with a smaller orifice.

3. 50-mesh screens for suction line and nozzles. Wettable powders will not go through the 100-mesh screens which are sometimes provided.

4. A spray boom. It should have nozzles adjustable for distance between nozzles on the boom and for height above the ground. This is especially important for band spraying.

5. A gauge to measure pressure accurately up to 100 pounds per square inch.

6. Flat fan nozzles. The best nozzle size for general use is equivalent to an 8004 Teejet. For most work, a wide-range nozzle—73 or 80 degrees—is best because the boom can be held close to the ground to reduce drift. This is most important when it is windy.

Cleaning Weed Control Sprayers

It is important to keep weed control sprayers clean. This is especially true if you use them to spray more than one crop or to apply fungicides and insecticides.

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

When cleaning a sprayer, thoroughly rinse the whole sprayer with water, inside and out, including boom, hoses and nozzles, both **before** and **after** cleaning. Partially fill the sprayer with water before you add the cleaning agent. Keep the pump running so that the cleaning solution will circulate throughout the sprayer. Do not leave corrosive cleaning agents in the tank or spray system more than 2 hours.

When you are using only pre-emergence sprays, a good rinsing with water is enough. For other spraying purposes, remove weed-killers from sprayers by adding 1 gallon of household ammonia or 5 pounds of sal soda to 100 gallons of water. Allow this solution to stand in the sprayer for **at least** 2 hours. Drain it out through the boom and nozzles, and rinse the sprayer with water. Do not let spray solutions stand in the tank overnight. Do not allow solutions to run into streams or other water sources.

Sprayer Calibration

One of the most important factors in effective weed spraying is accurate calibration—determining the amount of spray material applied per acre. A range of 20 to 60 gallons per acre, at a pressure of 20 to 60 pounds per square inch, is satisfactory.

Adjust the boom height so that the spray overlaps about a third at ground level. For overall spraying, using 80 degree nozzles, this places the nozzles about 18 to 20 inches apart on the boom and 18 to 20 inches from the sprayed surface.

A good way to calibrate a sprayer is to:

1. Fill the spray tank with water only.
2. Spray a measured area, in a field if possible, at a fixed tractor speed and pressure gauge setting. Be sure to allow for partial coverage if bands are used.
3. Measure the amount of water needed to refill the tank.
4. Divide this amount by the fraction of an acre sprayed to get the gallons applied per acre.
5. Mix the amount of chemical desired per acre with water to give this much spray material.

For example, if 10 gallons were applied on one-fourth acre, the volume of spray material applied would be 40 gallons per acre. If you change the tractor speed or gear, pressure setting, nozzle size, or number of nozzles, the amount of liquid applied per acre will be different and recalibration will be necessary.

Band Application in Row Crops

Since weeds in the crop row are usually the hardest to control, it may cost only 50 percent as much to spray herbicides in a band over the row rather than to cover the whole area.

For band applications, adjust for the area actually sprayed and not for the total acres in the field. For example, suppose the recommendation for a chemical is 4 pounds per acre, and 12-inch strips are sprayed over 36-inch rows. Only one-third of the ground area will be covered with spray materials, so only 1⅓ pounds of chemical (one-third of 4 pounds) will be required per acre. Four pounds of chemical will then cover 3 acres of the crop.

To adjust the sprayer for band application, place the boom so that there is one nozzle over each row and plug the nozzle between rows. This is not always easy with standard booms, but you can buy adjustable booms or adapters.

Trade names and formulations of herbicides are given for the convenience of the users. Other formulations of the same herbicides, or other herbicides with the same active ingredients may also be labeled for use on certain crops. The Cooperative Extension Service and Michigan State University do not endorse any product nor discriminate against those not mentioned.

WEED CONTROL RECOMMENDATIONS FOR VEGETABLE CROPS

Crop	Weed Problem	Chemical	Pounds Active Ingredient/Acre	Amount of Commercial Formulation/Acre	Time of Application	Remarks and Limitations
ASPARAGUS (Seedlings)	Germinating annuals	chloramben (AMIBEN) (2 lb/gal)	2 – 3	4 – 6 qt	Before asparagus and weeds emerge.	Use lowest rate on sandy soils. If soil is dry, irrigate after application.
	Emerged annuals	paraquat (PARAQUAT CL) (2 lb/gal)	½	1 qt	After weeds emerge, but before asparagus emerges.	For maximum knockdown, add a surfactant at 1 qt/100 gal of spray.
ASPARAGUS (Established one year or more)	Germinating annuals	diuron (KARMEX) (80 WP)	2 – 3	2½ – 4 lb	After tillage or chopping fern in the Spring and again after the harvest season, if necessary. Apply before weeds emerge.	Total dosage not to exceed 4.8 lb a.i./acre/year.
		simazine (PRINCEP) (80 WP)	2 – 4	2½ – 5 lb	Same as above.	Total dosage should not exceed 4 lb a.i./acre/year.
	Germinating annuals, Sandbur	metribuzin (SENCOR, LEXONE) (50 WP)	1 – 2	2 – 4 lb	Same as above.	Total dosage may not exceed 2 lb. active ingredient/acre/year. Two applications are necessary for good season-long sandbur control.
	Quackgrass	glyphosate (ROUNDUP) (3 lb/gal)	1½	2 qt	Apply immediately after the last harvest when all spears are snapped off.	Do not contact fern growth.
		dalapon (DOWPON, BASFAPON) (85% salt)	10	12 lb	Before, during, or at the end of the harvest season when quackgrass is 4 to 6 inches high.	Spray made during the harvest season should be made immediately following harvesting. Two applications may be necessary for complete control. Do not spray fern.
	Emerged milkweed, field bindweed, and other broadleaf weeds	glyphosate (ROUNDUP) (3 lb/gal)	1½ – 3	2 – 4 qt	Apply immediately after the last harvest when all spears are snapped off.	Do not contact fern growth.
		2,4-D Alkanolamine salts (FORMULA 40) (4 lb/gal)	2	2 qt	Before, during, or after the harvest season when weeds are growing rapidly.	Spray made during the harvest season should be made immediately after a harvest to minimize injury. When spraying *after* the harvest season, use drop nozzles to avoid spraying fern.

BEANS (LIMA)	Germinating annuals	chloramben (AMIBEN) (2 lb/gal)	2 – 3	4 – 6 qt	Before beans or weeds emerge.	If soil is dry, irrigate after application.
		dinoseb (PREMERGE) (3 lb/gal)	3 – 6	4 – 8 qt	Before beans emerge.	If possible, apply when soil is moist.
	Germinating grasses and some broadleaves	trifluralin (TREFLAN) (4 EC)	½ – ¾	½ – ¾ qt	Before planting.	Incorporate into soil 2 to 3 inches soon after spraying. Use lowest rate on sandy soils.
		profluralin (TOLBAN) (4 E)	½ – 1	½ – 1 qt	Before planting.	Incorporate into soil 2 to 3 inches soon after spraying. Use lowest rate on sandy soils.
	Emerged annuals, yellow nutsedge, Canada thistle	bentazon (BASAGRAN) (4 lb/gal)	¾ – 1	¾ – 1 qt	Early post-emergence.	Apply after beans have more than 1 expanded trifoliate leaf, or injury will occur. Two applications are needed for nutsedge and Canada thistle control. Do not apply more than 2 lb a.i./acre/year.
BEANS (SNAP)	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 prior to plowing.
	Germinating annuals	EPTC (EPTAM) (7 E)	3	2 qt	Before planting.	Incorporate into soil 2 to 4 inches immediately after spraying.
		dinoseb (PREMERGE) (3 lb/gal)	3 – 6	4 – 8 qt	Before emergence to crook stage on beans.	When applying at crook stage use lower rate of application. If possible, apply when soil is moist.
		chloramben (AMIBEN) (2 lb/gal)	2 – 3	4 – 6 qt	Before emergence.	If possible, apply when soil is moist. Use high rate on heavy, high organic matter soils, and for black nightshade control. Do not use on very light sandy soils.
	Germinating grasses and some broadleaves	trifluralin (TREFLAN) (4 EC)	½ – ¾	½ – ¾ qt	Before planting.	Incorporate into soil 2 to 3 inches soon after spraying. Use lowest rate on sandy soils. Does not control ragweed.
		profluralin (TOLBAN) (4 E)	½ – 1	½ – 1 qt	Before planting.	Incorporate into soil 2 to 3 inches soon after spraying. Use lowest rate on sandy soils. Does not control ragweed.
	Emerged annuals, yellow nutsedge, Canada thistle	bentazon (BASAGRAN) (4 lb/gal)	¾ – 1	¾ – 1 qt	Early post-emergence.	Apply after beans have more than 1 expanded trifoliate leaf, or injury will occur. Two applications are needed for nutsedge and Canada thistle control. Do not apply more than 2 lb a.i./acre/year.

Crop	Weed Problem	Chemical	Pounds Active Ingredient/Acre	Amount of Commercial Formulation/Acre	Time of Application	Remarks and Limitations
BEETS (TABLE)	Germinating and emerged annuals	pyrazon (PYRAMIN RB) (75 WP)	3 – 4	4 – 5 lb	From planting to before weeds are an inch high.	On muck soils, better control is often obtained by spraying small weeds after beets have two true leaves. Add crop oil at 1 gal/per 40 gal of spray or a surfactant such as X-77 at 1 pt/50 gal of spray.
	Germinating annuals, particularly grasses	cycloate (RO-NEET) (6 E)	3 – 4	2 – 3 qt	Before planting.	Incorporate into soil 2 to 3 inches after spraying. Use lowest rate on sandy soils. Not effective on muck soils.
BROCCOLI, CABBAGE, CAULIFLOWER (Seed beds or field seeded)	Germinating and emerged annuals	nitrofen (TOK) (25 E) (50 WP)	2 – 4	4 – 8 qt 4 – 8 lb	Before crop emergence, and again after plants have 3 true leaves.	Use the 4 lb/acre rate pre-emergence. On established plants use 2 lb/acre of wettable powder when weeds are about 1 inch high. Temporary burning may occur on some varieties after spraying, but yields are not reduced.
	Germinating annuals	CDEC (VEGADEX) (4 EC)	4	4 qt	Before crop and weeds emerge.	Irrigate after application if soil is dry.
	Germinating grasses and some broadleaves	trifluralin (TREFLAN) (4 EC)	½ – ¾	½ – ¾ qt	Before planting.	Incorporate into soil 2 to 3 inches soon after spraying. Use lowest rate on sandy soils. Not effective on muck soils.
BROCCOLI, CABBAGE, CAULIFLOWER (Transplants)	Emerged annuals	nitrofen (TOK) (50 WP)	2 – 4	4 – 8 lb	One or two weeks after transplanting before weeds are 1 inch high.	Use wettable powder formulation. Temporary burning may occur on some varieties after spraying, but yields are not reduced.
	Germinating grasses and some broadleaves	trifluralin (TREFLAN) (4 EC)	½ – 1	½ – 1 qt	Before transplanting.	Incorporate into soil 2 to 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.
		DCPA (DACTHAL) (75 WP)	8 – 10	10 – 13 lb	After transplanting and before weeds emerge.	Most effective on sandy soils for grass control.
CARROTS	Germinating or emerged annuals	linuron (LOROX) (50 WP)	¾ – 1½	1½ – 3 lb	Before emergence and after carrots are 3 to 4 inches high.	Use higher rate on weeds more than 2 inches high. 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 a.i./acre/year.

	Selected germinating annuals	chlorpropham (FURLOE-CHLORO IPC) (4 E)	4	4 qt	Before carrots emerge.	Provides weed control for 3 to 4 weeks on muck soil. Extremely effective on chickweed, smartweed, and field dodder.
	Emerged annuals	stoddard solvent (several trade names)	40 – 75 gallons		After carrots have 2 true leaves.	Do not spray within 42 days of harvest. Do not apply within 14 days after applying Lorox.
		nitrofen (TOK) (25 E) (50 WP)	3	6 qt 6 lb	After carrots form 2 true leaves and before weeds are 2 inches high.	Apply in 40 to 60 gal of water/acre. Especially effective on purslane. Does not control chickweed.
CELERY (Transplants)	Germinating or emerged annuals	prometryne (CAPAROL) (80 WP)	1 - 2	1¼ – 2½ lb	Use 2 applications, 2 and 6 weeks after transplanting and before weeds are 2 inches high.	Do not exceed 4 lb a.i./acre/year.
		linuron (LOROX) (50 WP)	1	2 lb	After transplanting and before weeds are 2 inches high.	Do not exceed 40 psi. Do not apply when temperatures exceed 85° F and do not mix with wetting agents or other pesticides.
		nitrofen (TOK) (25 E) (50 WP)	2	4 qt 4 lb	After transplanting and before weeds are 1 inch high.	Apply in 40 to 60 gal of water/acre.
CELERY (Outdoor seedbeds)	Emerged annuals	stoddard solvent (several trade names)	50 – 75 gallons		After celery has formed true leaves.	
CUCUMBERS (Seeded)	Germinating broadleaved annuals	chloramben-methyl ester (VEGIBEN) (2 E)	1½ – 3	3 – 6 qt	Before cucumbers and weeds emerge.	Do not use other formulations of VEGIBEN or AMIBEN on cucumbers. Heavy rains after application may cause some injury symptoms to occur. Use the lowest rate on sandy soils.
		naptalam (ALANAP) (2 lb/gal)	4	8 qt	Before cucumbers and weeds emerge.	Irrigate after application if soil is dry.
	Germinating grasses	bensulide (PREFAR) (4 E)	6	6 qt	Before or after planting, but before emergence.	With no irrigation, incorporate into soil 2 to 3 inches immediately after spraying and plant cucumbers. If irrigation is available, apply bensulide to soil surface after planting and irrigate immediately.

Crop	Weed Problem	Chemical	Pounds Active Ingredient/Acre	Amount of Commercial Formulation/Acre	Time of Application	Remarks and Limitations
	Germinating broadleaves and grasses	naptalam (ALANAP) (2 lb/gal) plus bensulide (PREFAR) (4 E)	3 – 4 plus 4 – 6	6 – 8 qt plus 4 – 6 qt	After planting or in 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 to 3 inches. Apply naptalam to surface after planting. Use the lowest rates on sandy soils.
		naptalam (ALANAP) (2 lb/gal) plus dinoseb (PREMERGE) (3 lb/gal)	4 plus 2	8 qt plus 3 qt	Before cucumbers emerge.	Plant seed to a depth of 1 inch or injury may result. Do not use on sandy soils.
CUCUMBERS (Transplants)	Germinating broadleaves	naptalam (ALANAP) (2 lb/gal)	4	8 qt	Before or after transplanting and before weeds emerge.	Irrigate after application if soil is dry. Apply with PREFAR before planting when grasses are a problem.
	Germinating grasses	bensulide (PREFAR) (4 E)	6	6 qt	Before transplanting.	Irrigate or incorporate into top 2 inches of soil.
DILL	Emerged annuals	stoddard solvent	40 – 75 gallons		After two true leaves are formed.	
EGGPLANT	Germinating annuals	DCPA (DACTHAL) (75 WP)	8	11 lb	After transplanting and before weeds emerge.	
ENDIVE, ESCAROLE	Germinating annuals	CDEC (VEGADEX) (4 EC)	4	4 qt	After seeding, before weeds emerge.	If soil is dry, irrigation will improve effectiveness.
	Germinating annuals, quack grass	pronamide (KERB) (50 WP)	1 – 1½	2 – 3 lb	Before or after seeding, and before weeds emerge.	Use only on mineral soils. Must be incorporated or irrigated into soil. Can be applied post-emergence to crop.
HORSERADISH	Germinating annuals	DCPA (DACTHAL) (75 WP)	8 – 10	11 – 13 lb	After seeding, before weeds emerge.	Not effective on muck soils.
	Germinating and emerged annuals	nitrofen (TOK) (25 E) (50 WP)	2 – 4	 4 – 8 qt 4 – 8 lb	Before crop emerges, and after weeds have 2–4 leaves.	Use 4 lb rate pre-emergence, 2 lb rate post-emergence.
LETTUCE	Germinating annuals	propham (CHEM HOE-IPC) (2 EC)	4 – 6	8 – 12 qt	Before lettuce and weeds emerge.	If soil is dry, irrigation will improve effectiveness. Use the lower rate when soil temperature is below 60° F.

		CDEC (VEGADEX) (4 EC)	4	4 qt	Before lettuce and weeds emerge.	If soil is dry, irrigation will improve effectiveness.
	Germinating annuals, quackgrass	pronamide (KERB) (50 WP)	1 – 2	2 – 4 lb	Before or after seeding lettuce, and before weeds emerge.	Use only on mineral soils. Must be incorporated or irrigated into soil. Can be applied postemergence to lettuce.
	Germinating annuals, especially grasses	benefin (BALAN) (1.5 LC)	1 – 1½	3 – 4 qt	Before planting.	Incorporate into soil 2 to 3 inches immediately after spraying. Not effective on muck soils.
MUSKMELONS (Transplants)	Germinating broadleaves	naptalam (ALANAP) (2 lb/gal)	4	8 qt	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) (4 E)	6	6 qt	Before transplanting.	Irrigate or incorporate into soil 2 to 3 inches immediately after spraying.
	Germinating broadleaves and grasses	naptalam (ALANAP) (2 lb/gal)	4	8 qt	Before transplanting.	Can be utilized under clear plastic mulch. Wait 5 days before transplanting.
		plus dinoseb (PREMERGE) (3 lb/gal)	plus 2	plus 3 qt		
MUSTARD, KALE, TURNIP GREENS	Germinating annuals	CDEC (VEGADEX) (4 EC)	4	4 qt	After planting, before weeds emerge.	If soil is dry, irrigation will improve effectiveness.
		DCPA (DACTHAL) (75 WP)	8 – 10	11 – 13 lb	After seeding, before weeds emerge.	Not effective on muck soils.
		trifluralin (TREFLAN) (4 EC)	½ – ¾	½ – ¾ qt	Before planting.	Incorporate into soil 2 to 3 inches soon after spraying. Use lowest rate on sandy soils. Not effective on muck soils.
ONIONS (Seeded)	Germinating annuals	CDAA (RANDOX) (4 EC)	3 – 6	3 – 6 qt	After planting until loop stage and again as needed after 2 true leaves form. Always apply before or just as weeds are emerging.	Particularly good on grasses, purslane, and pigweed. Apply Randox liquid no closer than 45 days before harvest. Use Randox granular no closer than 30 days before harvest.
Use these 2 herbicides according to your weed problem. A mixture of Randox + Chloro IPC at 3 plus 3 lbs. per acre usually controls more weeds than either chemical alone. Three or 4 applications at these lower rates give effective weed control without crop injury.		chlorpropham (FURLOE-CHLORO IPC) (4 E)	3 – 6	3 – 6 qt	After planting until loop stage and again as needed after 2 true leaves form. Always apply before or just as weeds are emerging.	Particularly good on purslane, chickweed, and smartweed. Apply no closer than 30 days before harvest.

Crop	Weed Problem	Chemical	Pounds Active Ingredient/Acre	Amount of Commercial Formulation/Acre	Time of Application	Remarks and Limitations
	Emerged broadleaved weeds	nitrofen (TOK) (25 E) (50 WP)	2	 4 qt 4 lb	After onions have 2 to 3 leaves and when weeds are less than 1 inch high.	Wettable powder formulation preferred. Do not apply with wetting agents or mix with liquid pesticides. Some temporary leaf burning may occur after application. Especially effective on purslane. Does not control chickweed. Wettable powder may cause abrasion to onion leaves if applied at pressures above 40 psi. Total dosage should not exceed 4 lb active ingredient/acre/year.
PARSNIPS	Germinating annuals	linuron (LOROX) (50 WP)	1 – 2	2 – 4 lb	Before parsnips emerge and again after they are 4 inches high. Apply when weeds are less than 2 inches high.	Do not apply when temperatures exceed 85° F. Do not apply at pressure greater than 40 psi.
	Emerged annuals	stoddard solvent (several trade names)	40 – 75 gallons		After 2 true leaves are formed.	
PEAS	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 prior to plowing.
	Emerged annuals	dinoseb (PREMERGE) (3 lb/gal)	1 – 2	1½ – 2½ qt	2 to 4-leaf stage.	Use 1 lb/acre when temperature 80° F., 1.5 lb when temperature 70° F., and 2 lb when temperature 60° F. Do not apply after peas are 6 inches high. Do not graze or feed vines to livestock within 40 days after application.
	Canada Thistle and emerged annuals	MCPB (CAN-TROL, THISTROL) (2 lb/gal)	½ – 1	1 – 2 qt	When peas have developed 6 to 12 nodes.	Do not apply later than 3 nodes before pea flowering or yields may be decreased. Do not apply when peas are under stress or when temperatures exceed 90° F.
	Germinating grasses and selected broadleaves	trifluralin (TREFLAN) (4 EC)	½ – ¾	½ – ¾ qt	Before planting.	Incorporate into soil 2 to 3 inches soon after spraying. Use lower rate on early plantings on sandy soils.
		propachlor (RAMROD, BEXTON) (65 WP)	3 – 4	4½ – 6 lb	Before peas emerge.	Use the lower rate on sandy soils.
	Germinating annuals	profluralin (TOLBAN) (4 E)	½ – 1	½ – 1 qt	Before planting.	Incorporate into soil 2 to 3 inches immediately after application. Use lower rate on sandy soils and higher rate on silt and clay. Can be used in peas interplanted with alfalfa.

	Emerged annuals, yellow nutsedge, Canada thistle	bentazon (BASAGRAN) (4 lb/gal)	¾ – 1	¾ – 1 qt	Early post-emergence.	Apply after peas have 3 pairs of leaves, or injury will occur. Two applications are needed for nutsedge and Canada thistle control. Do not apply more than 2 lb a.i./ acre/year.
PEPPERS (Seeded)	Germinating annuals	diphenamid (ENIDE) (50 WP)	5	10 lb	Before peppers and weeds emerge.	Irrigate after application if soil is dry.
		napropamide (DEVRINOL) (50 WP)	1 – 2	2 – 4 lb	Before planting.	Incorporate into soil 1 to 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.
PEPPERS (Transplants)	Germinating annuals	diphenamid (ENIDE) (50 WP)	5	10 lb	After transplanting and before weeds emerge.	Irrigate after application if soil is dry.
		napropamide (DEVRINOL) (50 WP)	1 – 2	2 – 4 lb	Before planting.	Incorporate into soil 1 to 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.
		trifluralin (TREFLAN) (4 EC)	½ – 1	½ – 1 qt	Before transplanting.	Incorporate into soil 2 to 3 inches soon after application. Use lowest rate on sandy soils.
RUTABAGA, TURNIP	Germinating annuals	DCPA (DACTHAL) (75 WP)	8	11 lb	Before crop and weeds emerge.	If soil is dry, irrigate lightly after application.
SPINACH	Germinating annuals	CDEC (VEGADEX) (4 EC)	4	4 qt	Before crop or weeds emerge.	Do not apply if temperatures are above 80° F. Irrigate after application if soil is dry. Do not use on muck soils.
SQUASH, PUMPKINS	Germinating annuals	chloramben (AMIBEN) (2 lb/gal)	2	4 qt	Before crop or weeds emerge.	If soil is dry, irrigate lightly after application.
SWEET CORN	Germinating broadleaves	atrazine (several trade names) (80 WP)	1	1¼ lb	After planting and before weeds are 1 inch high.	Observe label warnings on crop rotations.
	Germinating annuals, particularly grasses	atrazine (several trade names) (80 WP)	1	1¼ lb	Before crop or weeds emerge.	Observe label warnings on crop rotations.
		plus alachlor (LASSO) (4 EC)	plus 2	plus 2 qt		
	Emerged broadleaves	2,4-D amine salts (several trade names)	½		Spray after corn and weeds emerge and before corn is 8 inches tall.	Avoid drift onto sensitive crops.

Crop	Weed Problem	Chemical	Pounds Active Ingredient/Acre	Amount of Commercial Formulation/Acre	Time of Application	Remarks and Limitations
	Quackgrass	atrazine (80 WP)	3 – 4	4 – 5 lb	Before corn emerges.	Do not plant crops other than corn the following year.
		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 prior to plowing.
	Nutsedge	butylate (SUTAN +) (6.7 E)	4	2⅔ qt	Before planting.	Incorporate into soil 2 to 3 inches after spraying. Also controls annual grasses.
		alachlor (LASSO) (4 EC)	3	3 qt	Before corn emerges.	If soil is dry, shallow incorporation may increase effectiveness.
		EPTC (ERADICANE) (6.7 E)	4	2⅔ qt	Before planting.	Incorporate into soil 2 to 3 inches after spraying. Also controls annual grasses.
SWEET POTATOES	Germinating annuals	diphenamid (ENIDE) (50 WP)	5	10 lb	After planting and before weeds emerge.	
TOMATOES (Seeded)	Germinating annuals	diphenamid (ENIDE) (50 WP)	5	10 lb	Before tomatoes or weeds emerge.	If soil is dry, irrigate after application.
		napropamide (DEVRINOL) (50 WP)	1 – 2	2 – 4 lb	Before planting.	Incorporate into soil 1 to 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.
TOMATOES (Transplants)	Germinating annuals	napropamide (DEVRINOL) (50 WP)	1 – 2	2 – 4 lb	Before planting.	Incorporate into soil 1 to 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.
	Germinating annual grasses and broadleaves	trifluralin (TREFLAN) (4 EC)	½ – 1	½ – 1 qt	Before transplanting	Incorporate into soil 2 to 3 inches soon after application. Use lowest rate on sandy soils.
		diphenamid (ENIDE) (50 WP)	4 – 6	8 – 12 lb	After transplanting and before weeds emerge.	
	Germinating annuals, particularly broadleaves	chloramben (AMIBEN GRANULAR) (10 G)	2 – 4	20 – 40 lb	Apply 3 to 5 days after transplanting and before weed emergence or later in the season after a cultivation.	Use granular formulation only. Effective on ragweed and smartweed. Use lowest rate on sandy soils.
	Emerged broadleaved weeds	metribuzin (SENCOR, LEXONE) (50 WP)	¼	½ lb	Apply after transplants have started growth and before weeds are 2 inches tall. Repeat as necessary.	Do not apply within 1 day of application of other pesticides. Do not apply more than 1 lb active ingredients per season. Do not use hotcaps on treated plants within 7 days of application.

Names, Sources, and Formulations of Herbicides Used on Vegetable Crops.

Common Name	Trade Name[1] and Manufacturer	Concentration and Commercial Formulations[2]
alachlor	LASSO (Monsanto)	4 lb/gal L
atrazine	SEVERAL (Various)	80% WP; 4 lb/gal L
benefin	BALAN (Elanco)	1.5 lb/gal L
bensulide	PREFAR (Stauffer)	4 lb/gal L
bentazon	BASAGRAN (BASF)	4 lb/gal L
butylate	SUTAN + (Stauffer)	6.7 lb/gal L
CDAA	RANDOX (Monsanto)	4 lb/gal L
CDEC	VEGADEX (Monsanto)	4 lb/gal L
chloramben	AMIBEN (Amchem) VEGIBEN (Amchen)	2 lb/gal L; 10% G 2 lb/gal L
chlorpropham	FURLOE-CHLORO IPC (PPG)	4 lb/gal L
cycloate	RO-NEET (Stauffer)	6 lb/gal L
dalapon	DOWPON (Dow) BASFAPON	85% salt
DCPA	DACTHAL (Diamond Shamrock)	75% WP
dinoseb	PREMERGE (Dow)	3 lb/gal L
diphenamid	ENIDE (Upjohn)	50% WP
diuron	KARMEX (DuPont)	80% WP
EPTC	EPTAM (Stauffer) ERADICANE (Stauffer)	7 lb/gal L 6.7 lb/gal L
glyphosate	ROUNDUP (Monsanto)	3 lb/gal L
linuron	LOROX (DuPont)	50% WP
MCPB	CAN-TROL (Rhodia) THISTROL (Union Carbide)	2 lb/gal L
metribuzin	LEXONE (DuPont)	50% WP; 75% DF
	SENCOR (Mobay)	50% WP; 75% DF
napropamide	DEVRINOL (Stauffer)	50% WP
naptalam	ALANAP (Uniroyal)	2 lb/gal L
nitrofen	TOK (Rohm & Haas)	50% WP; 2 lb/gal L
paraquat	ORTHO PARAQUAT (Chevron)	2 lb/gal L
profluralin	TOLBAN (Ciba-Geigy)	4 lb/gal L
prometryn	CAPAROL (Ciba-Geigy)	80% WP
pronamide	KERB (Rohm & Haas)	50% WP
propachlor	RAMROD (Monsanto)	65% WP; 4 lb/gal L
	BEXTON (Dow)	65% WP; 4 lb/gal L
propham	CHEM HOE-IPC (PPG)	2 lb/gal L; 4 FL
pyrazon	PYRAMIN RB (BASF)	75.5% WP
simazine	PRINCEP (Ciba-Geigy)	80% WP
stoddard solvent	SEVERAL (Various)	100% oil
trifluralin	TREFLAN (Elanco)	4 lb/gal L
2,4-D	SEVERAL (Various)	

[1]"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.

[2]ae—acid equivalent, ai—active ingredient, DF—dry flowable, E or EC—emulsifiable concentrate, F or FL—flowable, G—granular, L—liquid, W or WP—wettable powder.

Effectiveness of Herbicides on Several Weed Species[1]

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	COMMON PURSLANE	COMMON RAGWEED	SMARTWEED	CRABGRASS	FOXTAILS	BARNYARD-GRASS	FALL PANICUM	STINKGRASS	QUACKGRASS	YELLOW NUTSEDGE
Preplant Incorporated Herbicides												
BALAN	G	F	G	P	P	E	E	E	E	E	P	P
DEVRINOL	G	P	G	P	P	E	E	E	E	E	P	P
EPTAM	G	G	G	F	F	E	E	E	E	E	G	G
PREFAR	G	P	P	P	P	E	E	E	E	E	P	P
RO-NEET	G	F	F	P	P	E	E	E	F	E	P	F
SUTAN +	F	P	P	P	P	E	E	E	E	E	P	G
TOLBAN	G	F	F	P	P	E	E	E	E	E	P	P
TREFLAN	G	F	F	P	P	E	E	E	E	E	P	P
Preemergence-Surface Applied Herbicides												
AATREX	E	E	E	E	E	G	G	G	P	G	G	G
ALANAP	G	G	G	F	G	P	P	P	P	P	P	P
AMIBEN	E	E	E	G	G	F	F	F	P	F	P	P
BLADEX	F	E	E	E	E	G	G	G	F	G	P	P
CAPAROL	E	E	G	G	F	G	F	F	F	F	P	P
CHEM HOE IPC	F	F	G	P	E	F	F	F	F	F	P	P
DACTHAL	F	P	P	P	P	P	E	E	G	E	P	P
ENIDE	G	F	G	P	F	E	E	E	E	E	P	P
FURLOE CHLORO IPC	F	F	G	P	E	F	F	F	F	F	P	P
KARMEX	E	E	E	E	E	F	E	E	F	E	P	P
KERB	P	F	G	F	F	F	F	F	P	F	G	P
LASSO	E	F	G	F	F	E	E	E	E	E	P	F
LEXONE	G	E	E	E	E	F	G	G	G	G	P	P
LOROX	E	E	E	E	G	G	E	G	F	E	P	P
PREFAR	G	P	P	P	P	E	E	E	E	E	P	P
PREMERGE	E	G	E	E	G	F	P	P	P	F	P	P
PRINCEP	E	E	E	E	E	F	E	E	F	E	F	P
PYRAMIN RB	G	F	G	G	G	F	F	F	F	F	P	P
RAMROD	G	F	G	F	F	E	E	E	E	E	P	P
RANDOX	G	F	G	G	P	G	G	G	F	G	P	P
SENCOR	E	E	E	E	E	F	G	G	G	G	P	P
TENORAN	E	G	G	F	F	F	F	F	P	F	P	P
TOK	G	G	E	P	G	F	F	F	F	F	P	P
VEGADEX	G	F	G	F	F	F	F	F	F	F	P	P
VEGIBEN 2E	E	E	E	G	G	G	F	F	F	F	P	P
Herbicides with Postemergence Activity												
AATREX	E	E	E	E	E	G	G	G	F	G	G	G
BASAGRAN	P	G	G	G	E	P	P	P	P	P	P	G
BASFAPON	P	P	P	P	P	F	G	G	G	G	G	P
BLADEX	F	G	G	G	G	G	G	G	G	G	P	P
CAPAROL	E	E	G	E	F	F	F	F	F	F	P	P
DOWPON	P	P	P	P	P	F	G	G	G	G	G	P
FORMULA 40	E	E	E	E	E	P	P	P	P	P	P	P
LEXONE	G	E	E	E	E	F	G	F	F	F	P	P
LOROX	E	E	G	E	E	P	P	F	P	F	P	P
PARAQUAT	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	F
SENCOR	G	E	E	E	E	F	G	F	F	F	P	P
STODDARD SOLVENT	E	E	E	P	E	E	E	E	E	E	F	F
TOK	G	G	E	G	G	P	P	P	P	P	P	P

[1]*Assuming 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. E = Excellent, G = Good, F = Fair, P = Poor*

[2]*Kill of top growth only.*

MICHIGAN STATE UNIVERSITY

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