

2003

Weed Control Guide for Vegetable Crops



Information Current as of November 1, 2002

Herbicide Information

Some herbicides containing the same active ingredients but having different trade names are marketed by more than one company. Also, some herbicides are produced in several formulations. Products recommended in this bulletin are commonly used formulations of common herbicides. Other products and formulations may be equally good. Check labels on containers to determine that the product is labeled for your intended target crop and the amount of product to use per acre.

Pesticide Information

This publication contains pesticide recommendations based on research and pesticide regulations. However, changes in pesticide registrations occur frequently. Some pesticides mentioned may no longer be available, and some may no longer be legal in your state. 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 can lead to civil fines and/or condemnation of the crop. If you have questions about the legality and/or registration status of pesticides, contact your county Extension office, pesticide dealer or manufacturer.

To protect yourself, others and the environment, always read the label before applying any pesticide.

2003 Weed Control Guide

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Environmental Protection and Herbicide Use

Profitable crop production depends on effective weed control. 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.

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 help avoid buildup of resistant weeds and pesticide residues in the soil.

Pesticides and the Environment

Groundwater is stored in water-bearing geological formations called **aquifers**. It moves through aquifers and is obtained at springs, streams or wells. Many people obtain their drinking water from wells. Well water is groundwater.

The upper level of the saturated zone in the soil is called the **water table**. The water table depth fluctuates, depending on the amount of water removed from the ground and the amount of water added by recharge.

Both surface water and groundwater are subject to contamination by **point and non-point source pollution**. Point source contamination refers to movement of a pesticide into water from a specific site. Non-point source contamination generally results from land runoff, precipitation, acid rain or percolation rather than from discharge at a single location.

Several factors influence the fate of herbicides in groundwater.

Adsorption is the binding of chemicals to soil particles. The amount and persistence of pesticide adsorption varies with pesticide properties, soil moisture, soil pH and soil texture. Soils high in organic matter or clay are the most adsorptive; coarse, sandy soils are much less adsorptive.

A soil-adsorbed herbicide is less likely to volatilize, leach or be degraded by microorganisms. It is also less available for absorption by plants.

Volatilization occurs when a solid or a liquid turns into a gas. A pesticide in a gaseous state can be carried away from the treated area by air currents. This is called **vapor drift**. Unlike the drift of sprays and dusts that can sometimes be seen during application, vapor drift is invisible.

Avoid applying volatile herbicides when conditions favor volatilization, such as temperature inversions. Herbicide labels usually mention the potential for volatility of herbicides. Volatilization can sometimes be reduced through the use of low volatile formulations or soil incorporation of the herbicide.

Photodegradation is the breakdown of herbicides by the action of sunlight. Herbicides applied to foliage or the soil surface may be broken down by exposure to light. Soil incorporation can reduce herbicide exposure to sunlight.

Microbial degradation occurs when microorganisms such as fungi and bacteria use a herbicide as a food source. Conditions that favor microbial growth include warm temperatures, favorable pH levels, adequate soil moisture, oxygen and fertility. Adsorbed herbicides are more slowly degraded because they are less available to some microorganisms.

Chemical degradation is the breakdown of a herbicide by soil processes not involving a living organism. Adsorption of the herbicides, soil pH, soil temperature and moisture influence the rate of degradation. Some

herbicides are more rapidly degraded on low pH soils.

Absorption is the process by which plants and microorganisms take up chemicals. Once absorbed, most herbicides are degraded within plants. Residues may persist inside the plant or be released back into the environment as the plant decays.

Runoff moves herbicides in surface water, either mixed in the water or bound to soil particles. The amount of herbicide runoff depends on the grade or slope of the field, the type of soil, the amount of rainfall (especially close to the time of application) and properties of the herbicide. For example, a herbicide applied to a saturated clay soil is highly susceptible to runoff. Established vegetation or plant residues reduce runoff.

Herbicide runoff is greatest when heavy rainfall occurs shortly after application. No-tillage, minimum-tillage and soil incorporation reduce runoff. Surface grading, drainage ditches and dikes, and the use of border vegetation can help reduce herbicide movement into surface water.

Leaching is the movement of herbicides through the soil into groundwater. Several factors influence leaching, including water solubility of the herbicide, soil structure and texture, and persistence of herbicide adsorption to soil particles. If a herbicide is strongly adsorbed to soil particles, it is less likely to leach, regardless of its solubility, unless the soil particles themselves move with the water flow.

Keeping Herbicides Out of Groundwater and Surface Water

It is very difficult to purify or clean contaminated groundwater or surface water. Management practices can be implemented to effectively reduce pesticide runoff and leaching and protect groundwater and surface water.

- **Use integrated crop management practices**—Minimize herbicide use by combining chemical control with other pest management practices such as tillage, cultivation, crop rotation and pest scouting.
- **Reduce compaction**—Surface water runoff increases when soils are compacted.
- **Rotate crops**—Crop rotations may provide more surface crop residue and may reduce the application of the same pesticides to a field.
- **Use conservation tillage practices**—Include no-till, minimum-till, cover crops, grass waterways and buffer strips.
- **Consider the geology of your area**—When planning herbicide applications, be aware of the water table depth and the permeability of the geological layers between the surface soil and groundwater.
- **Select herbicides carefully**—Choose herbicides with the least potential for leaching into groundwater or for runoff into surface water.
- **Transport pesticides safely**—Have pesticides delivered directly to your pesticide storage facility to avoid liability and potential accidents and spills in transit whenever possible. U.S. DOT shipping rules must be followed for transporting large quantities of pesticides, including proper placarding of the vehicle, liability insurance, special handling requirements, etc.
- **Follow label directions**—The label carries crucial information about the proper rate, timing and placement of the herbicide.
- **Calibrate accurately**—Equipment should be calibrated carefully and often.
- **Measure accurately**—Concentrates need to be carefully measured before they are placed into the spray tank. Do not “add a little extra” to ensure the herbicide will do a better job.
- **Avoid back-siphoning**—The end of the fill hose should remain above the water level in the spray tank at all times to prevent back-siphoning of

chemical into the water supply. Use an anti-backflow device when siphoning water directly from a well, pond or stream. These practices also reduce the likelihood of the hose becoming contaminated with herbicides.

- **Consider weather and irrigation**—If you suspect heavy or sustained rain, delay applying herbicides. Control the quantity of irrigation to minimize the potential for herbicide leaching and runoff.
- **Avoid spray drift and volatilization**—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 from the target area. Make every effort to AVOID PESTICIDE DRIFT!
- **Clean up spills**—Avoid spills. When they do occur, contain and clean them up quickly with an absorbent material such as cat litter. Chemicals spilled near wells and sinkholes can move directly and rapidly into groundwater. Chemicals spilled near ditches, streams or lakes can move rapidly into surface water.
- **Change the location of mixing areas**—Mix and load pesticides on an impervious pad, if possible. If mixing is done in the field, change the location of the mixing area regularly. Do not mix herbicides adjacent to the water source, and do not let the water run inadvertently onto the soil near the mixing area. This will increase herbicide leaching and/or runoff.
- **Dispose of wastes and containers properly**—All herbicide wastes must be disposed of in accordance with local, state and federal laws. Pesticide containers are considered hazardous waste until they are cleaned or disposed of properly. When possible, reduce the number of pesticide containers by using bulk or returnable containers.

All pesticide containers can be rendered non-hazardous waste by triple rinsing (or equivalent). The rinsate should be added to the spray tank. After triple rinsing, perforate both ends so the container cannot be reused.

All metal and plastic triple-rinsed containers should be recycled, if possible. If this option is not available, dispose of them in a state-licensed sanitary landfill. Dispose of all paper containers in a sanitary landfill or a municipal waste incinerator.

Do not bury or burn any pesticide containers. Do not reuse any empty pesticide containers for any purpose.

- **Store herbicides away from water sources**—Herbicide storage facilities should be situated away from wells, cisterns, springs and other water sources. Pesticides must be stored in a facility that will protect them from temperature extremes, high humidity and direct sunlight. The storage facility should be heated, dry and well ventilated. It should be designed for easy containment and cleanup of pesticide spills and made of materials that will not absorb any pesticide material that leaks out of a container. Store only pesticides in such a facility and always store them in their original containers.

Do not store any protective clothing or equipment in the pesticide storage facility. Store herbicides separately from insecticides and fungicides to avoid contamination of one material by another and accidental misuse.

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.

For additional information on pesticide storage, refer to Midwest Plan Service Bulletin 37, *Designing Facilities for Pesticide and Fertilizer Containment*, available from Agriculture and Biosystems Engineering Dept., 122 Davidson Hall, Iowa State University Ames, IA

50011; and Michigan Bulletin E-2335, *On-Farm Agrichemical Storage and Handling*.

Your state's water resources currently provide a vast supply of clean water for agriculture, homes and industry. They can ensure high water quality for future needs only if they are protected now. Be sure to understand how your activities, including herbicide usage, can affect them.

Michigan Groundwater Stewardship Program (MGSP)

The Michigan Groundwater Stewardship Program (MGSP) is a cooperative effort designed to reduce the risks of groundwater contamination associated with the use of pesticides and nitrogen fertilizers. The MGSP has been authorized through the year 2010 by the state legislature. It is funded by assessments on the sale of nitrogen fertilizers and pesticides. The assessment generates \$3.5 million each year that is used to deliver educational programs, technical assistance and cost-share programs that meet the needs and interests of pesticide and fertilizer users. Local MGSP's, usually associated with a county MSU Extension or Conservation District office, provide assisted farmstead pollution risk assessments (Farm*A*Syst and Field*A*Syst) and help in developing a groundwater stewardship plan, provide cost-share funds that are used to install groundwater stewardship practices, and conduct educational workshops and on-farm demonstrations.

The MGSP also sponsors the Spill Response Program (1-800-405-0101) to assist individuals dealing with pesticide, fertilizer and manure spills; Clean Sweep to dispose of unused and unwanted pesticides safely; container recycling to assist in the safe disposal of plastic pesticide containers; and the Michigan Emergency Tube project, which provides an emergency preparedness plan that helps meet the legal requirements of SARA Title III. Growers who participate in some of these programs are also eligible to obtain pesticide recertification credits.

Contact your MSU Extension, Conservation District or USDA NRCS representative to learn more about the MGSP serving your county.

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 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. (See also section on SARA Title III.)

Handling and Mixing Pesticides

Always wear protective clothing and equipment when handling, mixing and applying pesticides and during cleanup of application equipment. Always wear the personal protective equipment specified on the pesticide label.

Mix pesticides downwind and below eye level. Avoid excessive splashing and sloshing. If pesticides are spilled on you, wash them off immediately with lots of water and change your clothing. Resume spraying only after cleaning up any spills. Try to use closed handling/mixing systems when appropriate.

Keep unauthorized persons out of the area in which you handle pesticides.

Cleaning 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, usually 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 not exceeding labeled 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.

Protect Non-target Organisms

Applying pesticides carelessly can harm non-target organisms that are beneficial to agriculture and our environment. The best way to avoid injury of beneficial insects and microorganisms is to minimize pesticide use. Selective pesticides should be used whenever possible and applied only when necessary as part of a total pest management program.

Pesticides can be harmful to all kinds of vertebrates such as **fish** and **wildlife**. Most recognizable are the direct effects from acute poisoning. Fish kills often result from water pollution by a pesticide (usually insecticides). Pesticides can enter water via drift, surface runoff, soil erosion and leaching.

Bird kills from pesticides can occur when birds ingest the toxicant in granules, baits or treated seed; are exposed directly to the spray; consume a treated crop; drink and use contaminated water; or feed on pesticide-contaminated prey.

Worker Protection Standard

New federal rules for farm worker protection have been in effect since 1995. The Worker Protection Standard (WPS) covers pesticides that are used in the production of agricultural plants on farms and in forests, nurseries and greenhouses. The operators of these businesses are required to provide employees with:

- Information in the form of pesticide safety training, pesticide safety poster, access to labeling information and access to an application list of pesticide treatments on the establishment.
- Protection to ensure that employees will be protected from exposures to pesticides. Employers are required to prohibit handlers from applying pesticides in any way that will expose workers or others, exclude workers from areas being treated with pesticides, exclude workers from areas that remain under a restricted entry interval (REI), protect early entry workers who are doing permitted tasks in an area under REI, notify workers about treated areas, monitor handlers who are using highly toxic pesticides and provide instruction for use of personal protective equipment.
- Mitigation in the form of decontamination sites for washing up in the field and emergency assistance to make transportation available to a medical facility in the event of a pesticide-related injury or illness.

Details for compliance with the Worker Protection Standard as well as other regulations affecting worker safety can be obtained at your county MSU Extension office.

Right-to-Know

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

Record Keeping

The 1990 Farm Bill requires that all applicators who apply restricted use pesticides (RUP) keep records and maintain them for two years. Records to be kept include:

- Brand name or product name and the EPA registration number.
- Total amount of the product used.
- Size of the area treated.
- Crop, commodity, stored product or site to which the pesticide was applied.
- Location of the application.
- Month, day and year of the application.
- Name and certification number of the applicator or applicator's supervisor.

Any record form is acceptable as long as the required data are included. Penalties are up to \$500 for the first violation and up to \$1,000 for subsequent violations. Provisions for protecting the identity of the individual producers are included in the law. Commercial applicators must furnish a copy of the required records to the customer of the RUP application.

Endangered Species Act

To minimize the adverse impact of pesticides on endangered species, the EPA initiated the Endangered Species Act. The Michigan Department of Natural Resources (MDNR) administers the Michigan Endangered Species Act and maintains the federal and state endangered species lists in the state. Pesticide applications are a potential problem, particularly affecting birds, butterflies and moths. Alteration of the farm landscape can also negatively affect resident endangered species.

The Environmental Protection Agency (EPA) has determined threshold pesticide application rates that may affect listed species. This information is or will be included on pesticide labels. Counties with vulnerable endangered or threatened species will be identified on pesticide labels. Farmers must take the initiative and consult with the MDNR and the Fish and Wildlife Service (FWS) to be

sure there are no endangered species in their area. The Nature Conservancy, a private land and habitat conservation organization, is working with the MDNR and the FWS and is conducting a landowner contact program to work with landowners who own property important for endangered species protection.

SARA Title III Emergency Planning and Community Right-to-Know Act

The Emergency Planning and Community Right-to-Know Law under SARA Title III requires farmers to notify their State Emergency Response Commission (SERC), Local Emergency Planning Committee (LEPC) and local fire department that they store extremely hazardous materials along with the name and telephone number of the facility representative. Check with your state Department of Environmental Quality or Extension to receive a list of EPA established "extremely hazardous substances" and their threshold planning quantities.

The LEPC and fire chief may request maps of your storage facility and detailed lists of materials you store.

This law also requires, in the event of a spill, that the SERC, LEPC and National Response Commission be notified. The reportable quantities for spills is much less than for storage and can be obtained from the above sources. See Extension bulletin E-2575 for more details on SARA Title III and a list of commonly used extremely hazardous substances.

Right-to-Farm Act

Farmers in Michigan are protected from nuisance lawsuits under the Right-to-Farm Act if they follow specific acceptable management practices. The Generally Accepted Agricultural and Management Practices for pesticide utilization and pest control, nutrient utilization and manure management have been completed and are revised annually. Contact your Extension agent or regional office of the Michigan Department of Agriculture to obtain copies.

Spraying Equipment

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

- A tank with a volume of 100 to 300 gallons to reduce filling and mixing operations.
- A pump with a capacity of at least 10 gallons per minute and pressure up to 100 pounds per square inch (PSI).
- 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.
- Screens—There should be 50-mesh screens in the intake line and at each nozzle.
- Pressure gauge—A pressure gauge calibrated to 100 PSI should be mounted on the boom as near to the nozzle as possible.
- 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 it level when going over rough ground.
- Nozzles—Flat fan nozzles with 73 to 95-degree 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 and 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 the carrier (usually water) in gallons per acre (GPA). A rate of 10 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-degree 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 percent 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 the 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.

Key to Abbreviations in This Publication

a = acre	NIS = non-ionic surfactant
ae = acid equivalent	oz = ounce/ounces
ai = active ingredient	pt = pint/pints
AMS = ammonium sulfate	PHI = preharvest interval
AS = aqueous suspension	POST = postemergence
COC = crop oil concentrate	PPI = preplant incorporated
DF = dry flowable	PRE = preemergence
DG = dispersible granule	PSI = pounds per square inch
DS = dry soluble	qt = quart/quarts
E or EC = emulsifiable concentrate	RUP = restricted, use pesticide
ES = emulsifiable solution	SL = soluble liquid
F = flowable	S or SP = soluble powder
gal = gallon/gallons	UAN = urea ammonium nitrate, 28%
G = granule	W or WP = wettable powder
lb = pound/pounds	WSG = water-soluble granule
L = liquid	yr = year
ME = microencapsulated	

Table 1. Herbicide formulations, sources, toxicity, runoff and leaching potential, and REI.

Common Name	Trade Name ¹ and Manufacturer	Formulations	Runoff/Leaching ² Potential	LD ₅₀ mg/kg ³		REI ⁴
				Oral	Dermal	
• acetachlor	HARNESS (Monsanto)	7E	2/2	>5000	>5000	12 hrs
	SURPASS (DowAgro)	6.4E	2/2	1426-1942	>2240	12 hrs
• alachlor	LASSO (Monsanto)	4E	2/2	2000	7800	12 hrs
• atrazine	several	4L	2/1	1075-1886	>5000	12 hrs
bensulide	PREFAR (Gowan)	4E	1/2	704-819	>2000	12 hrs
bentazon	BASAGRAN (BASF)	4SL	3/1	2063	>10000	48 hrs
bromacil	HYVAR X (DuPont)	80W	2/1	1300-2000	>5000	12 hrs
bromoxynil	BUCTRIL (Bayer)	2E	2/3	780	>2000	12 hrs
clethodim	SELECT (Valent)	2E	3/3	2920-3610	>5000	24 hrs
clomazone	COMMAND (FMC)	3ME	2/2	>5000	>5000	12 hrs
clopyralid	STINGER (DowAgro)	3L	3/1	>5000	>5000	12 hrs
cycloate	RO-NEET (Cedar)	6E	2/2	3160-3690	>4640	12 hrs
DCPA	DACTHAL (Amvac)	75W	1/3	2000	>10000	12 hrs
dicamba	BANVEL, CLARITY (BASF)	4L	3/1	2629-3512	>2000	24 hrs
dimethenamid	OUTLOOK (BASF)	6E	2/2	849	>2000	12 hrs
diquat	REGLONE (Syngenta)	2L	1/3	600-810	260-315	24 hrs
diuron	KARMEX, DIREX (Griffin)	80DF	1/2	2900	>2000	12 hrs
endothall	DESICATE II (Cerexagri)	2L	3/2	233	481	48 hrs
EPTC	EPTAM (Syngenta)	7E	2/3	1325-1500	2750	12 hrs
	ERADICANE (Syngenta)	6E	2/3	2000-2870	>4000	12 hrs
ethalfuralin	CURBIT (UAP)	3E	1/3	3300	>5000	24 hrs
fluzifop-P	FUSILADE DX (Syngenta)	2E	1/3	>5000	>2000	12 hrs
fosamine	KRENITE (DuPont)	4L	2/3	>5000	>5000	—
glufosinate	RELY (Bayer)	1L	2/3	3570	>2000	12 hrs
glyphosate	ROUNDUP (Monsanto)	4L	1/3	>5000	>5000	12 hrs
	TOUCHDOWN (Syngenta)	4L	1/3	750	>2000	12 hrs
halosulfuron	PERMIT (Monsanto)	75WSG	2/2	1287	>5000	12 hrs
	SANDEA (Gowan)					
hexazinone	VELPAR (DuPont)	90SP	2/1	1100	>5000	24 hrs
imazethapyr	PURSUIT (BASF)	2L	3/1	3506	>2000	24 hrs
linuron	LOROX (Griffin)	50DF	1/2	4060-4833	>2000	24 hrs
MCPB	THISTROL (Nufarm)	2L	3/1	4738	>2000	12 hrs
s-metolachlor	DUAL MAGNUM (Syngenta)	7.6E	2/1	3425	>2000	24 hrs
metribuzin	SENCOR (Bayer)	75DF	2/1	2000-2795	>5000	12 hrs
napropamide	DEVINOL (United Phosphorus)	50DF	1/2	>5000	>2000	12 hrs
naptalam	ALANAP (Uniroyal)	2L	-/-	>5000	>20000	48 hrs
nicosulfuron	ACCENT (DuPont)	75WDG	3/1	>5000	>2000	4 hrs
norflurazon	SOLICAM (Syngenta)	80DF	1/2	1140	>2000	12 hrs
oryzalin	SURFLAN (DowAgro)	4AS	2/3	5000	>5000	24 hrs
oxyfluorfen	GOAL XL (DowAgro)	2E	-/-	>2000	>2990	24 hrs
• paraquat	GRAMOXONE MAX (Syngenta)	3L	1/3	283	>2000	24 hrs
pendimethalin	PROWL (BASF)	3.3E	1/3	3956	>2200	24 hrs
phenmedipham	SPIN-AID (Bayer)	1.3E	1/3	4000	>8700	24 hrs
primisulfuron	BEACON (Syngenta)	75DG	2/1	>5050	>2010	12 hrs
prometryn	CAPAROL (Syngenta)	4L	1/2	>5000	>2000	24 hrs
	COTTONPRO (Griffin)	4L	1/2	>5000	>2000	12 hrs
pronamide	KERB (DowAgro)	50W	2/1	>5000	>2000	24 hrs
pyrazon	PYRAMIN (BASF)	68DF	2/2	1160	>2000	12 hrs
quizalofop	ASSURE II (DuPont)	.88E	1/2	4100-5900	>2000	12 hrs
rimsulfuron	MATRIX (DuPont)	25DF	-/-	>5000	>2000	4 hrs
sethoxydim	POAST (BASF)	1.5E	2/3	4100	>5000	12 hrs
sulfometuron	OUST (DuPont)	75DG	2/2	>5000	>2000	4 hrs
terbacil	SINBAR (DuPont)	80W	2/1	>5000	>5000	12 hrs
triclopyr	GARLON (DowAgro)	4L	3/1	1350-1600	>2000	12 hrs
trifluralin	TREFLAN (DowAgro)	4E	1/3	3700	>5000	12 hrs
2,4-D	FORMULA 40 (Riverdale)	4L	3/2	375-699	>2000	48 hrs
	WEEDAR 64 (Nufarm)	4L	3/1	1161	1544	48 hrs
2,4-D + triclopyr	CROSSBOW (DowAgro)	3L	2/1	1000-2590	5000	—

¹ 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 also may be labeled for use on certain crops. The mention of trade names does not imply that they are endorsed or recommended over those of similar nature not listed.

² The runoff/leaching potential ratings are from the NRCS Field Office Technical Guide, Section II—Water Quality and Quantity Interpretations. 1 = large, 2 = medium, 3 = small.

³ The LD₅₀ is a standard toxicological term that indicates the number of milligrams (mg) of pesticide per kilogram (kg) of test animal body weight required to kill 50 percent of a test animal population. Values less than 10 indicate extremely high toxicity to mammals. The LD₅₀ data were obtained from the Material Safety Data Sheets.

⁴ REI = Restricted entry interval for the Worker Protection Standard. SL = see label.

• RESTRICTED-USE PESTICIDES. All or certain formulations of these herbicides have been classified as restricted-use pesticides (RUP) and are available only to certified applicators.

Table 2. Effectiveness of preplant incorporated and preemergence herbicides on weeds.

HERBICIDE (TRADE NAMES)	BARNYARDGRASS	CRABGRASS	FALL PANICUM	FOXTAILS	QUACKGRASS	COMMON LAMBSQUARTERS	COMMON PURSLANE	COMMON RAGWEED	GALINSOGA	MUSTARDS, WILD RADISH	NIGHTSHADES	PROSTRATE SPURGE	REDROOT PIGWEED	SMARTWEEDS	VELVETLEAF	YELLOW NUTSEDGE
ATRAZINE	G	F	P	G	G	E	E	E	G	E	E	G	E	E	F	F
ALANAP	P	P	P	P	P	G	F	F	F	F	P	P	G	G	G	P
CAPAROL	F	G	F	F	P	E	G	G	F	G	G	G	E	F	F	P
COMMAND	G	G	G	G	P	G	E	G	G	F	P	F	P	F	E	P
CURBIT	E	E	E	E	P	G	G	P	P	F	F	P	G	G	P	P
DACTHAL	E	G	G	E	P	F	F	P	P	P	P	F	F	P	P	P
DEVIRINOL	E	E	E	E	P	P	G	P	P	P	P	P	G	P	P	P
DUAL	E	E	E	E	P	F	F	P	G	P	G	G	G	F	P	G
EPTAM	E	E	E	E	G	G	P	F	F	F	F	P	G	F	F	G
GOAL	P	F	P	F	P	G	E	G	G	G	G	F	E	G	G	P
HARNESS/SURP	E	E	E	E	N	G	G	F	F	P	G	F	G	F	P	F
KARMEX/DIREX	E	F	F	E	P	E	E	E	G	G	G	F	E	E	F	P
KERB	F	F	P	F	G	F	G	F	P	P	P	F	P	F	P	P
LISSO	E	E	E	E	P	F	G	F	G	P	G	G	E	F	P	F
LOROX/LINEX	G	F	F	E	P	E	G	E	G	G	G	G	G	G	F	P
MATRIX	G	F	F	G	P	F	G	F	F	G	P	—	G	F	P	P
OUTLOOK	E	E	E	E	N	P	G	P	—	F	G	G	G	F	N	G
PERMIT, SANDEA	P	P	P	P	P	G	F	G	G	G	P	—	E	G	G	G
PREFAR	E	E	E	E	P	P	P	P	P	P	P	P	G	P	P	P
PROWL	E	E	E	E	P	G	F	P	F	P	P	G	G	F	F	P
PYRAMIN	F	F	F	F	P	E	G	G	P	G	G	F	G	G	P	P
RONEET	E	E	F	E	P	F	F	F	F	P	P	P	G	P	F	F
SENCOR	G	F	G	G	P	E	E	E	E	E	P	G	G	E	G	P
SINBAR	G	G	G	G	F	E	G	G	G	E	G	F	G	G	G	P
SOLICAM	E	E	E	E	F	F	F	G	G	E	F	G	F	G	F	F
SURFLAN	E	E	E	E	P	G	G	F	F	F	F	F	G	F	P	P
TREFLAN/TRILIN	E	E	E	E	P	F	F	P	P	P	P	P	G	P	P	P

E = Excellent, G = Good, F = Fair, P = Poor, — = insufficient data. Weed control will vary with soil type and weather.

Table 3. Effectiveness of postemergence herbicides on weeds.

HERBICIDE (TRADE NAMES)	BARNYARDGRASS	CRABGRASS	FALL PANICUM	FOXTAILS	QUACKGRASS	COMMON LAMBSQUARTERS	COMMON PURSLANE	COMMON RAGWEED	GALINSOGA	MUSTARDS, WILD RADISH	NIGHTSHADES	PROSTRATE SPURGE	REDROOT PIGWEED	SMARTWEEDS	VELVETLEAF	YELLOW NUTSEDGE
ACCENT	E	P	E	E	G	F	—	P	—	—	P	—	E	G	F	F
ATRAZINE	G	G	F	G	G	E	E	E	G	E	G	G	E	E	G	G
BASAGRAN	P	P	P	P	P	G	G	G	G	G	F	P	P	E	G	G
BEACON	P	P	G	F	G	F	—	E	—	F	G	—	E	G	G	F
BLADEx	G	F	G	G	G	G	G	G	G	G	G	G	F	G	F	P
BUCTRIL	P	P	P	P	P	E	P	G	G	G	G	F	F	G	G	P
CAPAROL	F	F	F	F	P	E	G	E	G	G	G	G	E	F	F	P
2,4-D	P	P	P	P	P	E	P	E	G	G	E	E	E	E	F	P
GOAL	P	P	P	P	P	F	E	G	F	F	G	P	E	F	G	P
GRAMOXONE	E	E	E	E	E ¹	E	E	E	G	E	E	G	E	E	G	G ¹
LOROX/LINEX	F	F	F	G	P	E	G	E	G	G	G	G	E	E	F	P
MATRIX	G	G	G	G	F	F	F	F	F	G	P	—	G	F	F	F
PERMIT, SANDEA	P	P	P	P	P	P	P	G	G	G	P	—	E	G	G	G
ROUNDUP	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	F
SENCOR	F	F	F	G	P	E	E	E	E	E	P	G	G	E	G	P
SINBAR	F	P	F	P	P	E	E	G	G	E	G	G	G	G	F	P
SPINAID	P	P	P	P	P	G	G	G	G	G	F	F	P	G	P	P
STINGER	P	P	P	P	P	P	P	G	G	P	F	P	P	F	P	P

E = Excellent, G = Good, F = Fair, P = Poor; — = insufficient data. Weed control will vary with soil type and weather.

¹Kills top growth only.

Weed Control Recommendations for Vegetable Crops

Crop	Weed Problem	Chemical	Lb Active Ingredient/Acre	Product/Acre	Remarks and Limitations
ASPARAGUS (Seed beds for crown production)	Preemergence annuals	terbacil (SINBAR 80W)	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 of 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 sandy soils.
	Emerged annuals	paraquat (GRAMOXONE MAX 3L)	0.56-1	1.5-2.7 pt	Apply after weeds emerge but before asparagus emerges. Include 1 pt NIS 100 gal of spray mix.
	Pre- or postemergence broadleaves	linuron (LOROX 50DF)	0.5-1.5	1-3 lb	MICHIGAN, MINNESOTA only. PREEMERGENCE: Plant seed 1-1.5 inches deep; spray a 1-inch band of activated charcoal over the rows at a rate of 300 lb/acre of actual area sprayed (15 lb/acre with 20-inch rows). Broadcast 2 lb of Lorox (1 lb ai) over the field. POSTEMERGENCE: When fern is 6-18 inches high and weeds are not over 4 inches high, broadcast 1-2 lb Lorox (1/2-1 lb ai). Do not exceed a total of 2 lb ai/acre/year.
ASPARAGUS (Newly planted crowns)	Postemergence grasses	sethoxydim (POAST 1.5E)	0.19-0.38	1-2 pt	Apply to actively growing grasses. Include 1 qt COC/acre. Maximum 5 pt/acre/year and 2 applications.
		fluzifop-P (FUSILADE DX 2E)	0.25-0.38	1-1.5 pt	Include 1 qt COC or 1 pt NIS/acre. Use high rate on quackgrass.
	Germinating or emerged broadleaves	linuron (LOROX 50 DF)	1-2	2-4 lb	MICHIGAN, MINNESOTA only. PREEMERGENCE: Broadcast 2-4 lb Lorox (1-2 lb ai) before crop emergence. POSTEMERGENCE: When fern is 6-18 inches high and weeds are not over 4 inches high, broadcast 2 lb Lorox (1 lb ai). Do not exceed a total of 2 lb ai/acre/year.
	Postemergence grasses	sethoxydim (POAST 1.5E)	0.19-0.38	1-2 pt	Apply to actively growing grasses. Include 1 qt COC/acre. Maximum 5 pt/acre/year and 2 applications.
		fluzifop-P (FUSILADE DX 2E)	0.25-0.38	1-1.5 pt	Include 1 qt COC or 1 pt NIS/acre. Use high rate on quackgrass.

ASPARAGUS
(Established
one year or more)

Emergent annuals	paraquat (GRAMOXONE MAX 3L)	0.56-1	1.5-2.7 pt	Apply before crop emergence or after the last harvest. Include 1 pt NIS/100 gal. 6-day PHI. RUP.
Preemergence annuals	diuron (KARMEX 80DF) (DIREX 80DF)	1.2-3	1.5-4 lb	Apply after tillage or chopping fern in the spring and again after the harvest season, if necessary. Do not exceed 4.8 lb ai/acre/year. 6-8 weeks' residual activity.
	norflurazon (SOLICAM 80DF)	2-4	2.5-5 lb	Apply in fall after chopping fern or in spring before emergence. Use lower rate on coarse, sandy soil. Apply only once per season. Gives 3-4 months' residual activity. Suppresses nutsedge. 14-day PHI.
	metribuzin (SENCOR 75DF)	0.56-2	0.75-2.6 lb	Apply after tillage or chopping fern in the spring and again after the harvest season, if necessary. Do not exceed 2 lb ai/acre/year. Two applications give good seasonlong sandbur control. 6-8 weeks' residual activity. 14-day PHI.
	terbacil (SINBAR 80W)	1.2-2	1.5-2.5 lb	Apply before spears emerge. Use lower rate on sandy soils. Maximum of 3 lb product and 2 applications/year. Do not plant other crops within 2 years of last application. 5-day PHI.
Postemergence broadleaves	halosulfuron (SANDEA 75W)	.023-.047	0.5-1 oz.	LABEL PENDING. MICHIGAN ONLY. Apply anytime during the season to kill nutsedge or broadleaves. Use drop nozzles in standing fern. Include 1 pt NIS/acre in spray mix. Maximum 2 oz/acre/year in 2 applications. 1-day PHI.
	linuron (LOROX 50DF)	1-2	2-4 lb	MICHIGAN, MINNESOTA only. Apply before or after crop emergence. Use high rate preemergence. Do not exceed 4 lb ai/acre/year. 6 weeks' residual activity. 1-day PHI.
	2,4-D amine salts (FORMULA 40) (3.7L)	1.4-1.9	1.5-2 qt	Apply before, during or after the harvest season when weeds are growing rapidly. During harvest, spray soon after a pick to minimize crop injury. In fern, use drop nozzles. 3-day PHI.
	clopyralid (STINGER 3L)	0.188-0.25	8-11 fl oz	Apply before or during harvest in 10-20 gpa. Apply to young annuals or perennials before bud stage. Controls dandelion, Canada thistle, horseweed, plantain, smartweed. May cause crooking of some spears. 12-hr PHI.
	dicamba (CLARITY 4L) (BANVEL 4L)	0.25-0.5	0.5-1 pt	Apply to actively growing weeds immediately after a harvest. Use high rate for control of perennial weeds. Apply in tank mix with 2,4-D or glyphosate for control of Canada thistle or field bindweed. Discard crooked spears at harvest. Do not exceed 1 pt/acre/year. 24-hr PHI.
Postemergence grasses	fluzifop-P (FUSILADE DX 2E)	0.25-0.38	1-1.5 pt	Apply to actively growing grasses. Include NIS or COC. Maximum 3 pt/acre/year. 1-day PHI.
	sethoxydim (POAST 1.5E)	0.19-0.38	1-2 pt	Apply to actively growing grasses. Include 1 qt COC in 20 gal water/acre. Maximum 5 pt and 2 applications/year. 1-day PHI.
Emergent perennials, quackgrass, volunteer asparagus	glyphosate (ROUNDUP 4L) (TOUCHDOWN 4L)	1-4	1-4 qt	Use lowest rate for annuals and higher rates for perennials. Include 1 pt NIS/acre. PREEMERGENCE: Apply at least 7 days before asparagus emergence. SPOT TREATMENT: Apply immediately after a clean harvest. Do not treat more than 10% of total field area. 5-day PHI. POSTHARVEST: Apply immediately after the last harvest and all spears have been removed. If spears regrow before application, allow fern to develop and apply as a shielded or directed spray. Do not allow herbicide to contact emerged spears or fern.

Crop	Weed Problem	Chemical	Lb Active Ingredient/Acre	Product/Acre	Remarks and Limitations
BEANS (Snap, Lima)	Emerged weeds before crop emergence	paraquat (GRAMOXONE MAX 3L)	0.56-1	1.5-2.7 pt	Apply before or after seeding but before crop emergence. Include 1 pt NIS/100 gal. RUP.
	Emerged quackgrass	glyphosate (ROUNDUP 4L)	2	2 qt	Apply to 8- to 10-inch quackgrass in the fall or spring prior to planting. Allow at least 5 days before plowing. Include 1 pt NIS/acre.
	Preemergence grasses and some broadleaves	EPTC (EPTAM 7E)	3	3.5 pt	SNAP BEANS only. Apply before planting and incorporate 2-4 inches immediately. For dry conditions.
		pendimethalin (PROWL 3.3E)	1-1.5	1.2-1.8 qt	Apply before planting and incorporate 1-2 inches deep. Use high rate on soils with 3% or more organic matter.
		s-metolachlor (DUAL MAGNUM 7.6E)	0.95-1.9	1-2 pt	Use lower rate on sandy soils with less than 3% organic matter. Incorpor. 1-2 inches before planting or apply preemergence.
		trifluralin (TREFLAN 4E)	0.5-0.75	1-1.5 pt	Apply before planting. Incorporate into soil 2-3 inches soon after spraying. Use lowest rate on sandy soils. Does not control ragweed.
	Preemergence broadleaves	clomazone (COMMAND 3ME)	0.15-0.25	0.4-0.67 pt	Apply to soil surface after seeding. Use lower rate on coarse soils. Controls velvetleaf and galinsoga. 45-day PHI.
		imazethapyr (PURSUIT 2L)	0.031-.047	2-3 fl oz	LIMA BEANS ONLY. Apply PPI or PRE after seeding. Use low rate on sandy soils. Do not apply after June 30. 30-day PHI. OBSERVE CROP ROTATION RESTRICTIONS.
		halosulfuron (SANDEA 75W)	0.23-0.47	0.5-1 oz	LABEL PENDING. Apply after seeding and before cracking. Do not apply postemergence. Maximum 1 oz/crop cycle; maximum 2 oz/acre/year in 2 crop cycles. 30-day PHI.
		bentazon (BASAGRAN 4L)	0.75-1	0.75-1 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 qt/acre/year.
BEETS, RED	Postemergence broadleaves, yellow nutsedge	sethoxydim (POAST 1.5E)	0.19-0.28	1-1.5 pt	Dry and succulent beans. Apply to actively growing grasses. Maximum of 4 pt/acre/year. Add 1 qt COC/acre. 15-day PHI for succulent beans and 30 days for dry beans.
		quizalofop (ASSURE II/0.88E)	0.04-0.08	6-12 fl oz	SNAP BEANS only. Apply to actively growing grasses in 10-20 gpa. Include 1 qt COC or .5 pt NIS/acre. 30-day PHI.
	Germinating and emerged broadleaves	pyrazon (PYRAMIN 68DF)	3.1-3.7	4.6-5.4 lb	Apply from planting until weeds are 2 inches high. On muck soils, better control is obtained by spraying small weeds after beets have 2 true leaves. Include 1 qt COC/acre.
	Preemergence 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.
	Postemergence broadleaves	phenmedipham (SPIN-AID 1.3E)	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. See label for weeds controlled and precautions. Does not control redroot pigweed. 60-day PHI.
	Postemergence grasses	sethoxydim (POAST 1.5E)	0.19-.28	1-1.5 pt	Apply to actively growing grasses. Use high rate on perennial grasses. Maximum of 3 pt/acre/year. Include 1 qt COC/acre. 60-day PHI.
		clethodim (SELECT 2E)	0.125	0.5 pt	Apply to actively growing grasses. Make multiple applications to control perennial grasses. Do not exceed 2 pt/acre/year. Include 1 qt COC/acre. 30-day PHI.

Emerged annuals and perennials	glyphosate (ROUNDUP 4L)	2-3	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 weed.
BROCCOLI, BRUSSELS SPROUTS, CABBAGE, CAULIFLOWER (Seeded or transplanted)	paraquat (GRAMOXONE MAX 3L)	0.56-1	1.5-2.7 pt	Apply before transplanting or before or after seeding but before crop emergence. Include 1 pt NIS/100 gal. RUP.
Preemergence grasses and broadleaves	trifluralin (TREFLAN 4E) (TRILIN 4E)	0.5-1	1-2 pt	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. Trifluralin may stunt transplanted crops or delay emergence of seeded crops when soil temperature is below 60° F.
	napropamide (DEVIRINOL 50DF)	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. Most effective in combination with Goal.
	s-metolachlor (DUAL MAGNUM 7.6E)	0.48-1.2	0.5-1.3 pt	KENTUCKY, MICHIGAN, WISCONSIN – TRANSPLANTED CABBAGE only. Apply to soil surface before or after transplanting. Do not tank mix with Goal. For use only by members of Wisconsin Kraut Growers Assoc., Kentucky Veg. Growers Assoc. and Michigan Veg. Council.
	clomazone (COMMAND 3ME)	0.25-0.5	0.7-1.3 pt	CABBAGE only. Apply before or after seeding or before transplanting. Use low rate for seeded cabbage. May cause early stunting or discoloration of cabbage. Controls velvetleaf. Observe rotational restrictions. 45-day PHI.
Preemergence broadleaves	oxyfluorfen (GOAL 2XL)	0.25-0.5	1-2 pt	TRANSPLANTED only. Apply to soil after final tillage but before transplanting. Do not apply after transplanting. Use low rate on coarse, sandy soil. If plants contact treated soil, some foliar burn may occur. Do not use on brussels sprouts. Use with trifluralin or napropamide.
Postemergence grasses	sethoxydim (POAST 1.5E)	0.19-.28	1-1.5 pt	Apply to actively growing grasses. Use high rate on perennial grasses. Maximum of 3 pt/acre/year. Include 1 qt COC/acre. 30-day PHI.
	clethodim (SELECT 2E)	0.1-0.125	6-8 fl oz	Include 1 qt COC/acre in spray mix. 30-day PHI.
Postemergence perennials	glyphosate (ROUNDUP 4L)	2-3	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 weed.

Crop	Weed Problem	Chemical	Lb Active Ingredient/Acre	Product/Acre	Remarks and Limitations
CARROT	Preemergence annuals	linuron (LOROX 50DF)	0.5-1	1-2 lb	PREEMERGENCE: MICHIGAN, OHIO, WISCONSIN only. Apply after seeding but before carrots emerge. Use low rate on light soils, and increase rate on soil containing more clay or organic matter.
		trifluralin	0.5-1	1-2 pt	Mineral soil only. Apply before planting and incorporate 2-3 inches soon after spraying. Use low rate on sandy soils.
	Postemergence broadleaves	linuron (LOROX 50DF)	0.75-1	1.5-2 lb	POSTEMERGENCE: Broadcast after carrots are 3 inches high. Do not apply when temperature is above 85°F. Do not apply at pressure above 40 PSI. Do not mix with other pesticides or surfactants. Do not apply within 14 days of any other pesticides when carrots are under stress. Do not exceed 2 lb ai/acre/year pre- and postemergence. 14-day PHI.
		metribuzin (SENCOR 75DF)	0.25	0.33 lb	Broadcast when carrots have 5-6 leaves. Do not apply during cool, cloudy weather or when temperature is above 85°F. Do not mix with other chemicals. Do not apply within 14 days of any other pesticides when carrots are under stress. Do not apply more than once per season if carrots are rotated with onions. Gives fair control of pineappleweed, marestail and groundsel. 60-day PHI.
	Postemergence grasses	fluazifop-P (FUSILADE DX 2E)	0.16-0.19	10-12 fl oz	Apply to actively growing grasses. Do not apply more than 6 pt/acre/year. Include 1 qt COC or 1 pt NIS/acre. 45-day PHI.
		sethoxydim (POAST 1.5E)	0.19-0.28	1-1.5 pt	Apply to actively growing grasses. Include 1 qt COC/acre. Maximum total of 5 pt/acre. 30-day PHI.
		clethodim (SELECT 2E)	0.125	0.5 pt	Apply to actively growing grasses. Make multiple applications to control perennial grasses. Do not exceed 2 pt/acre/year. Include 1 qt COC/acre. 30-day PHI.
	Postemergence perennials	glyphosate (ROUNDUP 4L)	2-3	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 weed.
CELERY (Transplanted)	Preemergence grasses, yellow nutsedge	s-metolachlor (DUAL MAGNUM 7.6E)	0.95-1.9	1-2 pt	MICHIGAN only. Apply before or immediately after transplanting. Use high rate on muck soils. Follow with 0.25 inch water within 7 days. For use by members of Michigan Vegetable Council only.
	Germinating or emerged annuals	prometryn	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 50DF)	0.75-1	1.5-2 lb	Apply after transplanting but before celery is 8 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.
	Postemergence grasses	sethoxydim (POAST 1.5E)	0.19-0.28	1-1.5 pt	Apply to actively growing grasses. Include 1 qt COC/acre. Maximum total of 3 pt/acre/season. 30-day PHI.
		clethodim (SELECT 2E)	0.125	0.5 pt	Apply to actively growing grasses. Make multiple applications to control perennial grasses. Do not exceed 2 pt/acre/year. Include 1 qt COC/acre. 30-day PHI.
	Postemergence perennials	glyphosate (ROUNDUP 4L)	2-3	2-3 qt	Apply to emerged perennials before planting in the spring or after harvest in the fall.

CHINESE VEGETABLES						
Preemergence grasses and broadleaves	bensulide (PREFAR 4E)	5-6	5-6 qt	Apply preplant or preemerge. Incorporate or water in. See label for crops included.		
Postemergence grasses	sethoxydim (POAST 1.5E)	0.19-0.28	1-1.5 qt	Chinese cabbage (bok choy, napa) and Chinese broccoli (gai laan). Apply to actively growing grasses. Include 1 qt COC/acre. Maximum 3 pt/acre/year. 30-day PHI.		
	clethodim (SELECT 2E)	0.1-0.125	6-8 fl oz	Apply to small grasses. Include 1 qt COC/acre in spray mix. 14 day PHI.		
CORN (Sweet, Pop)						
Emerged annuals	paraquat (GRAMOXONE MAX 3L)	0.56-1	1.5-2.7 pt	Apply before or after planting but before corn emerges to kill emerged weeds. RUP.		
Preemergence	atrazine (AATREX 4L)	1-2	1-2 qt	Apply after planting but before weeds are 1 inch tall. Do not plant any crop but corn for 18 months on land treated with more than 1 lb ai of atrazine. Use with a PRE grass herbicide. RUP.		
	alachlor (LASSO 4E)	2-4	2-4 qt	Apply soon after planting and before weeds emerge. Controls primarily grasses. RUP.		
	s-metolachlor (DUAL MAGNUM 7.6E)	1.2-1.9	1.3-2 pt	Apply soon after planting and before weeds emerge. Controls primarily grasses. Some nutsedge activity.		
	acetachlor (SURPASS 6.4EC) (HARNESS + 7E)	0.8-3	1-3.75 pt 0.9-3.4 pt	POPCORN only. May be preplant, incorporated or applied to surface after planting. Check label for rate for soil type. Controls many broadleaves and grasses. RUP.		
	dimethenamid-P (OUTLOOK 6E)	0.56-0.98	12-21 fl oz	Apply PPI or PRE. Check label for rate for soil type. Some hybrids may be sensitive. Controls many broadleaves, grasses and nutsedge. 50-day PHI.		
	EPTC (ERADICANE EXTRA 6E)	4-6	2.7-4 qt	Incorporate 2-3 inches immediately after application. Not effective on organic soils. Suppresses quackgrass and nutsedge. Controls primarily grasses.		
	pendimethalin (PROWL 3.3E)	1-2	1.2-2.4 qt	PROCESSING SWEET CORN only. ILLINOIS, MINNESOTA, WISCONSIN, only. Apply soon after planting. Do not incorporate. Controls many broadleaves and grasses, including wild proso millet.		
Postemergence broadleaves	2,4-D (WEEDAR 64 4L)	0.5	1 pt	SWEET CORN only. Apply after weeds emerge and before corn is 8 inches tall. Avoid drift to other crops. Other 2,4-D formulations may be labeled for use on sweet or popcorn. 2,4-D may injure some supersweets.		
	bentazon (BASAGRAN 4L)	0.75-1	1.5-2 pt	Apply when weeds are small. Apply twice for nutsedge control. Include 1 qt COC/acre.		
	bromoxynil (BUCTRIL 2E)	0.25-0.375	1-1.5 pt	POPCORN only. Apply prior to tasseling of corn. Controls only broadleaves. 30-day PHI.		
	halosulfuron (PERMIT 75WSG)	0.032	0.67 oz	Apply as broadcast or directed spray to corn from spike to layby stage, if needed, make a second application as a directed spray. Include 1 pt NIS/acre. Do not apply to Jubilee sweet corn or any corn under stress. Controls nutsedge. Observe rotational restrictions.		
	carfentrazone (AIM 40 WG)	0.008	0.33 oz	Use in tank mix with other post herbicides. Controls morning glory, lambsquarters, pigweed, velvetleaf. Some sweet corn cultivars are sensitive to Aim. Add .5 pt NIS/acre.		

Continued next page

Crop	Weed Problem	Chemical	Lb Active Ingredient/Acre	Product/Acre	Remarks and Limitations
CORN (Sweet, Pop) Continued	Postemergence grasses and broadleaves	primisulfuron (BEACON 75 DG)	0.036	0.76 oz	POPCORN only. Apply to corn 4-20 inches or taller. Beacon may injure popcorn. Controls many broadleaves and some grasses. Add .5% NIS or 1 qt COC/acre. 60-day PHI.
		nicosulfuron (ACCENT 75 SP)	0.031	0.67 oz	POPCORN only. Apply to corn up to 20 inches tall. Accent may injure popcorn. Controls many grasses and some broadleaves. Add .5% NIS or 1 qt COC/acre.
CUCUMBER (Pickling, Slicing)	Emerged weeds before crop emergence	paraquat (GRAMOXONE MAX 3L)	0.56-1	1.5-2.7 pt	Apply before seeding or transplanting cucumbers to kill emerged weeds. Include 1 pt NIS/100 gal. RUP.
	Preemergence annuals	ethafluralin + clomazone (STRATEGY 2.1L)	0.6-1.2 0.19-0.375	3-6 pt	Apply to soil surface after seeding, or as a banded spray between rows after transplanting. Needs .5 inch water within 2 days for activation.
		ethafluralin (CURBIT 3E)	0.75-1.13	2-3 pt	DIRECT-SEEDED CUCUMBERS. Use low rate on sandy soil. Apply to surface after seeding. Do not incorporate. Needs .5 inch of water within 5 days to activate it. Heavy rainfall may result in crop injury. TRANSPLANTED CUCUMBERS: Apply to soil between rows of plastic mulch. Do not apply over or under hotcaps, row covers or plastic mulch. Do not apply over the top of transplants.
		bensulide (PREFAR 4E)	4-6	4-6 qt	Apply and incorporate 0.5-1 inch before seeding or transplanting. Controls many annual grasses. May stunt crop if used under clear plastic. Usually used in tank mix with Alanap.
		naptalam (ALANAP 2L)	3-4	6-8 qt	PREEMERGENCE: Apply and incorporate before seeding or apply soon after seeding. Apply to moist soil or water in. Tank mix with Prefar or Command. May be used under clear plastic. POSTEMERGENCE: Apply after transplanting or just before cucumbers vine out. Controls several broadleaves.
		trifluralin (TREFLAN 4E)	0.5-1	1-2 pt	Direct the spray between rows of plants with 3-4 leaves. Cultivate shallowly to incorporate. Avoid contact with crop leaves.
		clomazone (COMMAND 3ME)	0.25-0.375	0.67-1 pt	Apply to soil surface after seeding. If replanting after poor stand, do not reapply Command. Good control of velvetleaf. Observe rotational restrictions. 45-day PHI.
	Preemergence and postemergence broadleaves	halosulfuron (SANDEA 75W)	0.024-0.047	0.5-1 oz	PREEMERGENCE: Apply after seeding but before cracking. Use low rate on light soils. Heavy rain and cool temperatures cause crop injury. POSTEMERGENCE: Apply when crop has 2-5 leaves and before flowering. Include 1 pt NIS/acre. Controls nutsedge. ROW MIDDLES: Apply to area between rows of plastic. UNDER PLASTIC: Apply just before laying plastic. Wait 7 days to plant. Use low rate. OVER PLASTIC: Use spot treatment for nutsedge control. 30-day PHI.
	Postemergence grasses	sethoxydim (POAST 1.5E)	0.19-0.28	1-1.5 pt	Apply to actively growing grasses. Include 1 qt COC/acre. Maximum total of 3 pt/acre/season. 14-day PHI.
		clethodim (SELECT 2E)	0.125	0.5 pt	Apply to actively growing grasses. Make multiple applications to control perennial grasses. Do not exceed 2 pt/acre/year. Include 1 qt COC/acre. 14-day PHI.

Postemergence weeds	paraquat (GRAMOXONE MAX 3L)	0.56	1.5 pt	MICHIGAN AND OHIO only. Use shields to protect crop. Apply in 20-30 gal water/acre. Do not exceed 30 PSI pressure. Do not allow spray to contact crop foliage. Maximum 3 applications per year.
Emerged perennials	glyphosate (ROUNDUP 4L)	2-3	2-3 qt	Apply to emerged perennials before planting the crop. Wait 3 days before planting.
EGGPLANT				
Emerged annuals	paraquat (GRAMOXONE MAX 3L)	0.56-1	1.5-2.7 pt	Apply before transplanting or as a directed spray postemergence. Include 1 pt NIS/100 gal. Do not exceed 30 PSI. RUP.
Preemergence	trifluralin (TRILIN 4E)	0.5-1	1-2 pt	Incorporate before transplanting.
	napropamide (DEVIRINOL 50DF)	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.
Postemergence broadleaves	halosulfuron (SANDEA 75W)	0.23-0.47	0.5-1 oz	LABEL PENDING. Apply as a directed spray to row middles for control of emerged nutsedge and small broadleaves. Avoid contact with crop. Maximum 2 oz/acre/year in 2 applications. Include 1 pt NIS/acre. 30-day PHI.
Postemergence grasses	sethoxydim (POAST 1.5E)	0.19-0.28	1-1.5 pt	Apply to actively growing grasses. Include 1 qt COC/acre. Maximum total of 4.5 pt/acre/season. 20-day PHI.
	clethodim (SELECT 2E)	0.125	0.5 pt	Apply to actively growing grasses. Make multiple applications to control perennial grasses. Do not exceed 2 pt/acre/year. Include 1 qt COC/acre. 20-day PHI.
Emerged perennials	glyphosate (ROUNDUP 4L)	2-3	2-3 qt	Apply to emerged perennials before planting the crop. Wait 3 days before planting.
ENDIVE, ESCAROLE, CHICORY				
Preemergence	pronamide (KERB 50W)	1-1.5	2-3 lb	Apply before or after seeding and before weeds emerge. Must be incorporated or irrigated into soil. Can be applied postemergence to crop. Weed control will be marginal on muck soil. 55-day PHI. RUP.
	trifluralin	0.5-1	1-2 pt	ENDIVE, ESCARGOLE, CHICORY, RADICCHIO, BELGIAN ENDIVE. Incorporate before seeding.
	bensulide (PREFAR 4E)	5-6	5-6 qt	ENDIVE, FLORENCE FENNEL, RADICCHIO. Apply preplant and incorporate or premerge and water in.
Postemergence grasses	fluzifop-P (FUSILADE DX 2E)	0.16-0.19	10-12 fl oz	Apply to actively growing grasses. Maximum of 6 pt/acre/year. Include 1 qt COC or 1 pt NIS/acre. 28-day PHI.
	sethoxydim (POAST 1.5E)	0.19-0.28	1-1.5 pt	Apply to actively growing grasses. Include 1 qt COC/acre. Maximum total of 3 pt/acre/season. 5-day PHI.
Postemergence perennials	glyphosate (ROUNDUP 4L)	2-3	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 weed. Include 1 pt NIS/acre.

Crop	Weed Problem	Chemical	Lb Active Ingredient/Acre	Product/Acre	Remarks and Limitations
GARLIC	Emerging weeds before crop emergence	paraquat (GRAMOXONE MAX 3L)	0.56-1	1.5-2.7 pt	Apply before or after planting but before crop emerges. Include 1 pt NIS/100 gal. Will kill small grains planted for windbreak and any emerged crop plants. 60-day PHI. RUP.
	Preemergence annuals	pendimethalin (PROWL 3.3E)	0.5-1.5	1.2-3.6 pt	Apply preemergence or postemergence at the 1- to 5- leaf stage. Follow with rainfall or irrigation within 7 days. Max. 3.6 pt/acre/year. 45-day PHI.
		bensulide (PREFAR 4E)	5-6	5-6 qt	Apply preplant or preemergence. Incorporate or water in. Not effective on high organic soils.
	Postemergence broadleaves	bromoxynil (BUCTRIL 2E)	0.5-1	1-2 qt	Apply after garlic emerges but before it is 12 inches high. Do not apply within 112 days of anticipated harvest. RUP.
	Postemergence grasses	fluzifop-P (FUSILADE DX 2E)	0.16-0.19	10-12 fl oz	Apply to actively growing grasses. Maximum of 6 pt/acre. Include 1 qt COC or 1 pt NIS/acre. 45-day PHI.
		sethoxydim (POAST 1.5E)	0.19-0.28	1-1.5 pt	Apply to actively growing grasses. Include 1 qt COC/acre. Maximum total of 4.5 pt/acre. 30-day PHI.
		clethodim (SELECT 2E)	0.1-0.25	6-16 fl oz	Apply to actively growing grasses. Include 1 qt COC/acre in spray mix. Use high rate for perennial grasses and annual bluegrass. Maximum of 68 fl oz/acre/year. 45-day PHI.
	Emerging perennials	glyphosate (ROUNDUP 4L)	2-3	2-3 qt	Apply to emerged perennials before planting the crop. Wait 3 days before planting.
HORSERADISH	Preemergence	oxyfluorfen (GOAL 2XL)	0.5	2 pt	Apply to established plantings or new plantings before plants emerge. Mix trash into soil before application.
	Perennials	glyphosate (ROUNDUP 4L)	2-3	2-3 qt	Apply to emerged perennials before planting in the spring or after harvest in the fall.
	Postemergence grasses	sethoxydim (POAST 1.5E)	0.19-0.47	1-2.5 pt	Apply to actively growing grasses. Include 1 qt COC/acre. Maximum of 5 pt/acre/year. 60-day PHI.
		clethodim (SELECT 2E)	0.125	0.5 pt	Apply to actively growing grasses. Make multiple applications to control perennial grasses. Do not exceed 2 pt/acre/year. Include 1 qt COC/acre. 30-day PHI.
LEEK	Postemergence grasses	sethoxydim (POAST 1.5E)	0.19-0.28	1-1.5 pt	Apply to actively growing grasses. Include 1 pt COC/acre. Maximum 4.5 pt total/acre. 30-day PHI.
	Perennials	glyphosate (ROUNDUP 4L)	2-3	2-3 qt	Apply to emerged perennials before planting in the spring or after harvest in the fall.
LETTUCE (-Head, leaf)	Emerging annuals	paraquat (GRAMOXONE MAX 3L)	0.56-1	1.5-2.7 pt	PREEMERGENCE: Apply before or after seeding but before lettuce emerges. Include 1 pt NIS/100 gal. MI AND OH. POSTEMERGENCE SHIELDED SPRAY: Apply 1.5 pt/acre to weeds 1-6 inches tall. Shield lettuce completely and apply to space between rows. RUP.
	Preemergence annuals	pronamide (KERB 50W)	1-2	2-4 lb	Apply before or after seeding but before weeds emerge. Incorporate or irrigate into the soil. Can be applied postemergence to lettuce. Use high rate on muck soil. MICHIGAN AND OHIO only: Use 4-6 lb ai (8-12 lb of product) to improve weed control on muck soil. 55-day PHI. RUP.

	bensulide (PREFAR 4E)	5-6	5-6 qt	Apply preplant and incorporate or preemerge and water in. Not effective on muck soil.
Postemergence grasses	sethoxydim (POAST 1.5E)	0.19-0.28	1-1.5 pt	Apply to actively growing grasses. Include 1 qt COC/acre. Maximum 3 pt/acre/year. Head lettuce: 30-day PHI; leaf lettuce: 15-day PHI.
	clethodim (SELECT 2E)	0.1-0.125	6-8 fl oz	Leaf lettuce only. Include 1 qt COC/acre in spray mix. 14-day PHI.
Postemergence perennials	glyphosate (ROUNDUP 4L)	2-3	2-3 qt	Apply to emerged perennials before planting in the spring or after harvest in the fall.
Germinating annuals	terbacil (SINBAR 80W)	0.4-1.6	0.5-2 lb	PREEMERGENCE: Apply in spring before mint emerges. POSTEMERGENCE: Apply up to 1 lb product plus 1 pt NIS/acre. Max. of 2 lb product/acre/year. Carryover injury to other crops. 60-day PHI.
Preemergence broadleaves	oxyfluorfen (GOAL 2XL)	0.5	1 qt	INDIANA, MICHIGAN, WISCONSIN only. Apply before mint emerges to avoid crop injury. May cause temporary stunting of mint.
Postemergence broadleaves	bentazon (BASAGRAN 4L)	1	1 qt	Apply postemergence when weeds are small. Include 1 qt COC/acre. Do not exceed 4 lb/acre/year.
	bromoxynil (BUCTRIL 2E)	0.25	1 pt	Apply during dry weather with temperatures below 70°F. Effective on small weeds. May cause temporary stunting and leaf chlorosis of mint. 70-day PHI.
	clopyralid (STINGER 3L)	0.188-0.375	0.5-1 pt	Apply up to 1 pt in fall or 0.5 pt in spring. Maximum of 1 pt/acre/year. Controls composites (e.g., Canada thistle, dandelion), legumes, smartweeds, nightshades, plantains and some other weeds. 45-day PHI.
	glyphosate (ROUNDUP 4L)	1-3	1-3 qt	Use as a spot spray to kill perennials. Mint sprayed will be killed. Treat a maximum of 1/10 of any acre. 7-day PHI.
Postemergence grasses	sethoxydim (POAST 1.5E)	0.19-0.28	1-1.5 pt	Apply to actively growing grasses. Include 1 qt COC/acre. Maximum 5 pt and 2 applications/year. 20-day PHI.
	quizalofop (ASSURE 11 0.88E)	0.04-0.07	6-10 fl oz	Apply in 10-40 gal/acre to actively growing grass. Use high rate on perennial grass. Include 1 qt COC or .5 pt NIS/acre. 30-day PHI.
	clethodim (SELECT 2E)	0.1-0.25	6-16 fl oz	Apply to small grasses. Include 1 qt COC/acre in spray mix. 21-day PHI.

MINT

Crop	Weed Problem	Chemical	Lb Active Ingredient/Acre	Product/Acre	Remarks and Limitations
MUSKMELON	Emerged weeds before crop emergence	paraquat (GRAMOXONE MAX 3L)	0.56-1	1.5-2.7 pt	Apply before seeding or transplanting melons to kill emerged weeds. Include 1 pt NIS/100 gal. RUP.
	Preemergence broadleaves and grasses	ethalfluralin + clomazone (STRATEGY 2.1L)	0.6 -1.2 0.19 -0.375	3-6 pt	Apply to soil surface after seeding, or as a banded spray between rows after transplanting. Needs .5 inch water within 2 days for activation. Use lower rate on light soil.
		ethalfluralin (CURBIT 3E)	0.75-1.13	2-3 pt	DIRECT-SEEDED MELONS: Use low rate on light, sandy soil. Apply to soil surface within 2 days of seeding. Do not incorporate. Needs .5 inch of rain or irrigation within 5 days to activate it. Heavy rainfall after application may cause crop injury. TRANSPLANTED MELONS: Apply to soil between rows of plastic mulch. Do not apply over or under row covers or plastic mulch. Do not spray over the top of transplants.
		clomazone (COMMAND 3ME)	0.15-0.25	0.4-0.67 pt	Apply to soil surface before transplanting or after seeding. Use low rate on coarse soils. 45-day PHI.
		bensulide (PREFAR 4E)	4-6	4-6 qt	Apply and incorporate 0.5-1 inch before seeding or transplanting. Controls many annual grasses. May stunt crop if used under clear plastic. Usually used in tank mix with Alanap.
		naptalam (ALANAP 2L)	3-4	6-8 qt	PREEMERGENCE: Apply and incorporate before seeding or apply soon after seeding. Apply to moist soil or water in. Usually used in tank mix with Prefar. May be used under clear plastic. POSTEMERGENCE: Apply after transplanting or just before melons vine out. Controls several broadleaves.
		trifluralin (TREFLAN 4E)	0.5-1	1-2 pt	Direct the spray between rows when plants have 3-4 leaves. Cultivate shallowly to incorporate. Avoid contact with crop leaves.
	Preemergence and postemergence broadleaves	halosulfuron (SANDEA 75 W)	0.23-0.47	0.5-1 oz	LABEL PENDING. PREEMERGENCE UNDER PLASTIC: Apply SANDEA and then lay plastic. Wait 7 days before planting melon. POSTEMERGENCE BAREGROUND: Apply over the top of plants as broadcast spray when melons have 2 to 5 leaves. Wait 14 days after transplanting on bareground before application. Include 1 pt NIS. POSTEMERGENCE PLASTIC: Direct the spray to soil between plastic. Maximum 1.67 oz/crop cycle. 57-day PHI.
	Postemergence grasses	sethoxydim (POAST 1.5E)	0.19-0.28	1-1.5 pt	Apply to actively growing grasses. Include 1 qt COC/acre. Maximum total of 3 pt/acre/season. 14-day PHI.
		clethodim (SELECT 2E)	0.125	0.5 pt	Apply to actively growing grasses. Make multiple applications to control perennial grasses. Do not exceed 2 pt/acre/year. Include 1qt COC/acre. 14-day PHI.
	Postemergence shielded emerged weeds	paraquat (GRAMOXONE MAX 3L)	0.56	1.7 pt	MICHIGAN AND OHIO only. Use shields to protect crop. Apply in 20-30 gal water/acre. Do not exceed 30 PSI pressure. Do not allow spray to contact crop foliage. Maximum 3 applications/year. RUP.
	Emerged perennials	glyphosate (ROUNDUP 4L)	2-3	2-3 qt	Apply to emerged perennials before planting the crop. Wait 3 days before planting.

MUSTARD, COLLARDS, KALE, KOHLRABI, TURNIP GREENS	Emerg weeds before crop emergence	paraquat (GRAMOXONE MAX 3L)	0.56-1	1.5-2.7 pt	COLLARDS AND TURNIPS. Apply before or after seeding but before crop emergence. Include 1 pt NIS/100 gal. RUP.
	Preemergence	bensulide (PREFAR 4E)	5-6	5-6 qt	Apply preplant or preemerge and water in. Not effective on muck soils.
	Postemergence grasses	trifluralin (TREFLAN 4E) sethoxydim (POAST 1.5E) clethodim (SELECT 2E)	0.5-0.75 0.19-0.28 0.1-0.125	1-1.5 pt 1-1.5 pt 6-8 fl oz	Apply before planting. Incorporate 2-3 inches into soil soon after spraying. Use low rate on sandy soils. Not effective on muck. COLLARD, KALE, KOHLRABI, MUSTARD, RAPE GREENS. Apply to actively growing grasses. Include 1 qt COC/acre. Maximum total of 3 pt/acre. 30-day PHI. Apply to small grasses. Include 1 qt COC/acre in spray mix. 14-day PHI.
OKRA (Seeded or transplanted)	Perennials	glyphosate (ROUNDUP 4L)	2-3	2-3 qt	Apply to emerged perennials before planting in the spring or after harvest in the fall. Include 1 pt NIS/acre.
	Preemergence	trifluralin	0.5-1	1-2 pt	Apply before planting. Incorporate 2-3 inches into soil immediately after spraying.
	Emerg perennials	glyphosate (ROUNDUP 4L)	2-3	2-3 qt	Apply to emerged perennials before planting or after harvest. Include 1 pt NIS/acre.
ONION, SHALLOT, DRY BULB (Seeded, sets, transplants)	Emerg weeds before crop emergence	paraquat (GRAMOXONE MAX 3L)	0.56-1	1.5-2.7 pt	Apply before or after seeding but before crop emerges. Include 1 pt NIS/100 gal. Kills small grains planted for windbreak and any emerged crop plants. 60-day PHI. RUP.
	Preemergence	pendimethalin (PROWL 3.3EC)	0.5-2	0.6-2.4 qt	MUCK SOIL: Apply 2-2.4 qt/acre preemergence or at transplanting and after the 2-leaf stage. Make third application at the 6- to 9- leaf stage. Pack soil well over the row. Wait 5 days after seeding barley to apply. Maximum total of 7.2 qt/acre/year. MINERAL SOIL: Apply 1.2-3.6 pt/acre to onions with 2-9 leaves. Maximum 3.6 pt/acre/year. 45-day PHI.
	Preemergence annuals, yellow nutsedge	s-metolachlor (DUAL MAGNUM 7.6E)	0.63-1.2	0.67-1.3pt	MICHIGAN only. Apply after 2-leaf stage of onions. On muck soils, make second application 3-4 weeks after first. For use by members of Michigan Vegetable Council only. 60-day PHI.
Postemergence broadleaves	oxyfluorfen (GOAL 2XL)	0.031-0.125	2-8 fl oz	TRANSPLANTS: Apply 1 pt within 2 days of transplanting for PRE control. DRY ONIONS: Apply as broadcast during sunny weather after onion 2-leaf stage. Use high rate for large weeds. Do not exceed 2 pt/acre/year. 45-day PHI.	
	bromoxynil (BUCTRIL 2E)	0.13-0.25	0.5-1 pt	Apply before onions emerge or to onions with 2-5 leaves. Application to younger or older onions may cause crop injury. Apply in a minimum of 50 gal water/acre, after 2 sunny days, when soil and onion leaves are dry and temperature is 70-80°F to avoid crop injury. Controls mustards, lambsquarters and smartweed.	
	fluzifop-P (FUSILADE DX 2E)	0.16-0.19	10-12 fl oz	Apply to small, actively growing grasses. Include 1 qt COC or 1 pt NIS/acre. 45-day PHI.	
Perennials	sethoxydim (POAST 1.5E)	0.19-0.28	1-1.5 pt	Apply to actively growing grasses. Include 1 qt COC/acre. Maximum total of 4.5 pt/acre. 30-day PHI.	
	clethodim (SELECT 2E)	0.1-0.25	6-16 fl oz	Apply to actively growing grasses. Include 1 qt COC/acre in spray mix. Use high rate for perennial grasses and annual bluegrass. Maximum of 0.5 lb/acre/year. 45-day PHI.	
	glyphosate (ROUNDUP 4L)	2-3	2-3 qt	Apply to emerged perennials before planting in the spring or after harvest in the fall.	

Crop	Weed Problem	Chemical	Lb Active Ingredient/Acre	Product/Acre	Remarks and Limitations
ONION, GREEN	Preemergence	DCPA (DACTHAL 75W)	6-10.5	8-14 lb	MINERAL SOIL only. Apply after planting or after a clean cultivation to moist soil, or follow with .25 inch rain or irrigation. Use higher rate on heavier, darker soils.
	Postemergence grasses	sethoxydim (POAST 1.5E)	0.19-0.28	1-1.5 pt	Apply to actively growing grasses. Include 1 qt COC per acre. Maximum total of 4.5 pt/acre. 30-day PHI.
	Preemergence	linuron (LOROX 50DF)	0.75-1	1.5-2 lb	STATES EAST OF MISSISSIPPI RIVER only. Mineral and muck soil: Apply after seeding but before crop emergence. MUCK SOIL: One additional postemergence application at 0.5 lb ai/acre. 30-day PHI.
PARSNIP		bensulide (PREFAR 4E)	5-6	5-6 qt	Apply preplant or preemergence. Incorporate or water in. Not effective on muck soil.
	Perennials	glyphosate (ROUNDUP 4L)	2-3	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 weed.
	Postemergence grasses	sethoxydim (POAST 1.5E)	0.19-0.28	1-1.5 pt	Apply to actively growing grasses. Include 1 qt COC/acre. Maximum total of 3 pt/acre. 15-day PHI.
	Preemergence	linuron (LOROX 50DF)	1-2	2-4 lb	Apply before parsnips emerge and again after they are 4 inches tall. Do not apply above 85°F or 40 PSI.
	Postemergence grasses	clethodim (SELECT 2E)	0.125	0.5 pt	Apply to actively growing grasses. Make multiple applications to control perennial grasses. Do not exceed 2 pt/acre/year. Include 1 qt COC/acre. 30-day PHI.
PEAS	Perennials and annuals	glyphosate (ROUNDUP 4L)	2-3	2-3 qt	Apply to emerged perennials before planting or after harvest.
	Emerged weeds	paraquat (GRAMOXONE MAX 3L)	0.56-1	1.5-2.7 pt	Apply before or after seeding but before crop emergence. Include 1 pt NIS/100 gal. RUP.
	Preemergence	trifluralin (TREFLAN 4E)	0.5-0.75	1-1.5 pt	Apply before planting. Incorporate 2-3 inches soon after spraying. Use lower rate on early plantings on sandy soils.
		s-metolachlor (DUAL MAGNUM 7.6E)	0.95-1.9	1-2 pt	Use lower rate on sandy soils with less than 3% organic matter. Apply preemergence only. Do not incorporate on English peas.
		clomazone (COMMAND 3ME)	0.5	1.3 pt	Apply to soil surface before planting. Use in combination with other herbicides to broaden weed control spectrum. Cover crops planted after pea harvest may suffer some stand reduction.
Germinating or emerged broadleaves	imazethapyr (PURSUIT 2L)	.047	3 fl oz	Apply PPI or PRE. Do not apply to peas treated with Treflan. POSTEMERGENCE: Apply 2-3 fl oz after 1 true leaf stage. Include 1 pt NIS/50 gal water. 30-day PHI. OBSERVE CROP ROTATION RESTRICTIONS. PURSUIT MAY CAUSE CARRYOVER INJURY.	
Postemergence broadleaves, Canada thistle	MCPB (THISTROL) (2 lb/gal)	0.5-1	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 temp. exceeds 90°F.	
Postemergence broadleaves, nutsedge	bentazon (BASAGRAN 4L)	0.75-1	0.75-1 qt	Apply after peas have 3 pairs of leaves. Two applications are needed for nutsedge and Canada thistle control. Do not exceed 2 qt/acre/year. Do not add COC on peas. 30-day PHI.	

Postemergence grasses	sethoxydim (POAST 1.5E)	0.19-0.28	1-1.5 pt	Dry and succulent peas. Apply to actively growing grasses. Use high rate on perennial grasses. Max. 4 pt/acre/year. Include 1 qt COC/acre. 15-day PHI for succulent peas and 30 days for dry peas.
	quizalofop (ASSURE 110.88 E)	0.04-0.08	6-12 fl oz	Apply to actively growing grasses in 10-20 gpa. Include 1 qt COC or .5 pt NIS/acre. 30-day PHI.
Perennials	glyphosate (ROUNDUP 4L)	2	2 qt	Apply in the fall or spring prior to planting. Include 1 pt NIS/acre. Wait 5 days before plowing.
Preemergence	s-metolachlor (DUAL MAGNUM 7.6E)	0.95-1.9	1-2 pt	Use low rates on soils with less than 3% organic matter. Incorporate 1-2 inches before planting, or apply to soil after planting.
	trifluralin	0.5-1	1-2 pt	Apply before planting and incorporate 2-3 inches. Use lower rate on sandy soils.
Germinating or emerged broadleaves	imazethapyr (PURSUIT 2L)	0.063	4 fl oz	Apply PPI or PRE after seeding. POSTEMERGENCE: Apply when southern peas are at least 3 inches high. Include 1 pt NIS/50 gal water. 30-day PHI. OBSERVE CROP ROTATION RESTRICTIONS. PURSUIT MAY CAUSE SEVERE CARRYOVER INJURY.
Postemergence broadleaves, nutsedge	bentazon (BASAGRAN 4L)	0.75-1	0.75-1 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 qt acre/year. Do not add COC on peas.
Postemergence grasses	sethoxydim (POAST 1.5E)	0.19-0.28	1-1.5 pt	Use on all dry and succulent peas. Apply to actively growing grasses. Max. 4 pt/acre/year. Include 1 qt COC/acre. 15-day PHI for succulent peas and 30 days for dry peas.
Emerged perennials	glyphosate (ROUNDUP 4L)	2-3	2-3 qt	Apply to emerged perennials before planting or after harvest.

PEAS
(Southern)

Crop	Weed Problem	Chemical	Lb Active Ingredient/Acre	Product/Acre	Remarks and Limitations
PEPPER (Transplanted)	Emerged weeds before crop emergence	paraquat (GRAMOXONE MAX 3L)	0.56-1	1.5-2.7 pt	Apply before transplanting or before or after seeding but before crop emergence. Include 1 pt NIS/100 gal. RUP.
	Preemergence	napropamide (DEVRINOL 50DF)	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.
		trifluralin	0.5-1	1-2 pt	Apply before transplanting. Incorporate 2-3 inches soon after application. Use lower rate on sandy soils.
		clomazone (COMMAND 3ME)	0.375-1	1-2.7 pt	ALL PEPPERS EXCEPT BANANA. Apply before transplanting. Set plant roots below herbicide.
		s-metolachlor (DUAL MAGNUM 7.6E)	0.48-0.95	0.5-1 pt	KENTUCKY and MICHIGAN only. BELL PEPPERS only. Apply to soil surface before or within 48 hr after transplanting. Do not incorporate. Suppresses nutsedge and nightshade. For use by members of Michigan Veg. Council and Kentucky Veg. Growers Assoc. only. 60-day PHI.
	Postemergence broadleaves	halosulfuron (SANDEA 75W)	0.23-0.47	0.5-1 oz	LABEL PENDING. Apply as a directed spray to row middles for control of emerged nutsedge and broadleaves. Avoid contact with crop or plastic. Include 1 pt NIS/acre. Maximum 2 oz/acre/year in 2 applications. 30 day PHI.
	Postemergence grasses	sethoxydim (POAST 1.5E)	0.19-0.28	1-1.5 pt	Apply to actively growing grasses. Include 1 qt COC/acre. Maximum total of 4.5 pt per acre. 20-day PHI.
		clethodim (SELECT 2E)	0.125	0.5 pt	Apply to actively growing grasses. Make multiple applications to control perennial grasses. Do not exceed 2 pt/acre/year. Include 1 qt COC/acre. 20-day PHI.
	Postemergence emerged weeds	paraquat (GRAMOXONE MAX 3L)	0.56	1.5 pt	Use shields to protect crop. Apply in 20-30 gal water/acre water. Do not exceed 30 PSI pressure. Do not allow spray to contact crop foliage. Maximum 3 applications/year. 30-day PHI.
	Emerged perennials	glyphosate (ROUNDUP 4L)	2-3	2-3 qt	Apply to emerged perennials before planting the crop. Wait 3 days before planting.

POTATO

Emerged quackgrass and other perennials	glyphosate (ROUNDUP 4L)	2	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.
Preemergence annual grasses and broadleaves	EPTC (EPTAM 7E)	4-6	2.3-3.4 qt	Incorp. 3 inches deep immediately after application. Use high rate for nutsedge and quackgrass. Not effective on muck soils. Follow with delayed preemerge application of linuron or metribuzin.
	s-metolachlor (DUAL MAGNUM 7.6E)	0.95-1.9	1-2 pt	Apply soon after planting. Follow with delayed preemerge application of linuron or metribuzin. May apply to emerged potatoes. 40-day PHI.
	pendimethalin (PROWL 3.3E)	0.75	1.8 pt	Apply soon after planting. Do not use on muck soil or soil with less than 1.5% OM. Needs rain within 7 days to activate. Follow with a delayed preemerge application of linuron or metribuzin.
Delayed preemergence broadleaves and grasses	linuron (LOROX 50DF)	1	2 lb	Follow preemerge treatments listed above. Apply before potatoes emerge but after weeds have emerged.
	metribuzin (SENCOR 75DF)	0.5	.67 lb	Follow preemerge treatments listed above. Apply just before potatoes emerge and after weeds have emerged but are less than 1 inch tall. Do not use on Atlantic or Shepody varieties.
	rimsulfuron (MATRIX 25DF)	0.023	1.5 oz	Apply after hilling or drag-off before potatoes and weeds emerge. Needs moisture for activation. 60-day PHI.
Postemergence broadleaves and grasses	metribuzin (SENCOR 75DF)	0.25	0.33 lb	Apply postemergence over the top of potatoes. Avoid spraying during the 12- to 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. 60-day PHI.
	rimsulfuron (MATRIX 25DF)	0.016	1 oz	Apply over top of potatoes to small weeds. Include 2 pt NIS/100 gal. When tank-mixing with metribuzin, use 1 pt NIS/100 gal and follow precautions on metribuzin label. 60-day PHI.
Postemergence grasses	sethoxydim (POAST 1.5E)	0.19-0.28	1-1.5 pt	Apply to actively growing grasses. Use high rate on perennial grasses and large annual grasses. Include 1 qt COC/acre. 30-day PHI.
	clethodim (SELECT 2E)	0.125	0.5 pt	Apply to actively growing grasses. Make multiple applications to control perennial grasses. Do not exceed 2 pt/acre/year. Include 1 qt COC/acre. 30-day PHI.
Vine kill	diquat (REGLONE 2L)	0.25	1 pt	Apply to mature potato vines. Make a second application within 5 days if vines are very thick. For Russet Burbank, use 2 pt in first application, 1 pt in second. Include 2 pt NIS/100 gal. 7-day PHI. RUP.
	endothall (DESICATE II 2L)	0.75-1	1.5-2 qt	Apply in 5-40 gal water/acre. Use high rate on lush, dense vines. Add AMS or NIS to improve vine kill. 10-day PHI.
	paraquat (GRAMOXONE MAX 3L)	0.25-0.47	11-20 fl oz	Do not use on potatoes grown for seed or storage. Apply in a min. of 20 gal/acre. Use 20 oz for quick vine kill. Use 2 appls. of 11 oz for dense vines. Wait 5 days between treatments. 3-day PHI. RUP.
	glufosinate (RELY 1 L)	0.375	3 pt	Do not use on potatoes for seed. Apply in 20-100 gpa with ground sprayer. Include 17 lb AMS/100 gal. 9-day PHI.

Crop	Weed Problem	Chemical	Lb Active Ingredient/Acre	Product/Acre	Remarks and Limitations
PUMPKIN, SQUASH	Emergent weeds before crop emergence	paraquat (GRAMOXONE MAX 3L)	0.56-1	1.5-2.7 pt	Apply before or after seeding but before crop emergence. Include 1 pt NIS/100 gal. RUP.
	Preemergence	ethafluralin + clomazone (STRATEGY 2.1L)	0.6 - 1.2 0.19-0.375	3-6 pt	Apply to soil surface after seeding, or as a banded spray between rows after transplanting. Needs .5 inch water within 2 days for activation. Use lower rate on light soil.
		bensulide (PREFAR 4E)	5-6	5-6 qt	Apply to moderately dry, well-worked soil and incorporate 1-2 inches before seeding. 3-4 weeks' residual activity.
		ethafluralin (CURBIT 3E)	0.75-1.13	2-3 pt	PUMPKINS, SUMMER/WINTER SQUASH. Apply to soil surface after seeding, or between rows after transplanting. Needs .5 inch rain within 5 days for activation. Heavy rains may cause crop injury.
	clomazone (COMMAND 3ME)	0.25-0.5	0.67-1.33 pt	SUMMER/WINTER SQUASH, PROCESSING PUMPKINS: Apply to soil before transplanting or after seeding. Use lower rate on coarse soils. Apply to soil between rows of plastic before transplanting. Do not apply under plastic. Do not use on bright orange or pink <i>C. maxima</i> cultivars. Do not use on jack-o'-lantern pumpkins. Use in tank mix with a preemergence grass herbicide. 45-day PHI.	
	halosulfuron (SANDEA 75W)	0.23-0.32	0.5-0.67 oz	LABEL PENDING. PREEMERGENCE: apply after seeding and before cracking. Heavy rainfall or cool weather may cause crop injury after application. POSTEMERGENCE: apply when crop has 2 or more leaves and before flowering. Include 1 pt NIS/acre. PROCESSING PUMPKIN AND SQUASH: Maximum 1 oz product/application. SUMMER SQUASH: apply between rows as directed spray. Do not spray over top of plants. Maximum 2 oz product/acre/year. 30-day PHI for all crops.	
	sethoxydim (POAST 1.5E)	0.19-0.28	1-1.5 pt	Apply to actively growing grasses. Include 1 qt COC/acre. Maximum total of 3 pt/acre/season. 14-day PHI.	
	clethodim (SELECT 2E)	0.125	0.5 pt	Apply to actively growing grasses. Make multiple applications to control perennial grasses. Do not exceed 2 pt/acre/year. Include 1 qt COC/acre. 14-day PHI.	
	paraquat (GRAMOXONE MAX 3L)	0.56	1.5 pt	MICHIGAN AND OHIO only. Use shields to protect crop. Apply in 20-30 gal water/acre. Do not exceed 30 PSI pressure. Do not allow spray to contact crop foliage. Maximum 3 applications per year.	
	glyphosate (ROUNDUP 4L)	2-3	2-3 qt	Apply to emerged perennials before planting the crop. Wait 3 days before planting.	
RADISH	Preemergence	trifluralin	0.5-0.75	1-1.5 pt	Apply and incorporate before seeding. Not effective on muck soil.
	Emergent perennials	glyphosate (ROUNDUP 4L)	2-3	2-3 qt	Apply to emerged perennials before planting.
	Postemergence grasses	clethodim (SELECT 2E)	0.125	0.5 pt	Apply to actively growing grasses. Make multiple applications to control perennial grasses. Do not exceed 1 pt/acre/year. Include 1 qt COC/acre. 15-day PHI.

RHUBARB Fall application	Preemergence	pronamide (KERB 50W)	1-2	2-4 lb	MICHIGAN only. Apply in the fall before November 1 to suppress quackgrass and winter annuals. Do not apply to rhubarb the year of planting. 218-day PHI. RUP.
	Emerged weeds before crop emergence	paraquat (GRAMOXONE MAX 3L)	0.56-1	1.5-2.7 pt	For use on dormant rhubarb. Use higher rate for heavier weed infestation. Do not exceed 2 applications per season. Gives some suppression of quackgrass. Include 1 pt NIS/100 gal. RUP.
	Postemergence grasses	clethodim (SELECT 2E)	0.1-0.125	6-8 fl oz	Include 1 qt COC/acre in spray mix. 30-day PHI.
RUTABAGA, TURNIP	Perennials	glyphosate (ROUNDUP 4L)	2-3	2-3 qt	Apply to emerged perennials before planting.
	Preemergence	DCPA (DACTHAL 75W)	8-10.5	10.5-14 lb	Apply before crop and weeds emerge. If soil is dry, irrigate lightly after application.
		trifluralin (TREFLAN MTF 4L)	0.5-1	1-2 pt	WISCONSIN only. Apply and incorporate before seeding or transplanting. Use lower rate on light soils.
	Postemergence grasses	clethodim (SELECT 2E)	0.125	0.5 pt	Apply to actively growing grasses. Make multiple applications to control perennial grasses. Do not exceed 2 pt/acre/year. Include 1 qt COC/acre. 30-day PHI.
	Emerged perennials and annuals	glyphosate (ROUNDUP 4L)	2-3	2-3 qt	Apply to emerged perennials before planting or after harvest. May be applied with wiper applicator in the crop. Do not allow herbicide to contact crop foliage.
SPINACH	Perennials	glyphosate (ROUNDUP 4L)	2-3	2-3 qt	Apply to emerged perennials before planting in the spring or after harvest in the fall.
	Preemergence annuals, nutsedge	cycloate (RO-NEET 6E)	3	2 qt	OHIO and ILLINOIS only. Mineral soil only. Apply before planting and incorporate 2-3 inches immediately.
	Postemergence grasses	sethoxydim (POAST 1.5E)	0.19-0.28	1-1.5 pt	Apply to actively growing grasses. Include 1 qt COC/acre. Maximum total of 3 pt/acre/season. 15-day PHI.
		clethodim (SELECT 2E)	0.1-0.125	6-8 fl oz	Apply to small grasses. Include 1 qt COC/acre in spray mix. 14-day PHI.

Crop	Weed Problem	Chemical	Lb Active Ingredient/Acre	Product/Acre	Remarks and Limitations
STRAWBERRY	Preemergence	DCPA (DACTHAL 75W)	6-9	8-12 lb	Apply 12 lb Dacthal within 5 days of transplanting as a broadcast spray. On established beds, apply 8-12 lb product in early spring before first bloom or after harvest.
		napropamide (DEVIRINOL 50DF)	3-4	6-8 lb	Apply before weeds emerge to newly transplanted or established crop as a broadcast surface spray. Light rain or irrigation after application will improve weed control. May inhibit daughter plant establishment.
	Germinating annuals	terbacil (SINBAR 80W)	0.1-0.3	2-6 oz	Apply to plants established at least 6 months. Apply after renovation before new growth begins or in late fall. Do not apply more than 8 oz/acre/year. Do not use on soils with less than 2% organic matter. May injure rotational crops.
	Postemergence annuals	paraquat (GRAMOXONE MAX 3L)	0.56	1.5 pt	Apply as a directed spray, using shields to protect strawberry plants. Do not allow spray to contact strawberry plants. 21-day PHI. RUP.
	Postemergence broadleaves	2,4-D amine salts (FORMULA 40) (3.8L)	0.93	1 qt	Apply after harvest at renovation (after mowing). Do not apply to actively growing plants after August 1 or misshapen fruit may be produced the next season.
	Postemergence grasses	sethoxydim (POAST 1.5E)	0.19-0.38	1-2 pt	Apply to actively growing grasses. Use high rate on perennial grasses. Include 1 qt COC/acre. 7-day PHI.
SWEET POTATO	Perennials	clethodim (SELECT 2E)	0.125	0.5 pt	Apply to actively growing grasses. Make multiple applications to control perennial grasses. Do not exceed 2 pt/acre/year. Include 1 qt COC/acre. 4-day PHI.
		glyphosate (ROUNDUP 4L)	2-3	2-3 qt	Apply to emerged perennials before planting in the spring or after harvest in the fall.
	Preemergence	clomazone (COMMAND 3ME)	0.5-1.2	1.3-3.3 pt	Apply to soil surface before transplanting. May be applied after transplanting at 1.5 pt/acre. Use low rate on coarse soils. 95-day PHI.
		napropamide (DEVIRINOL 50DF)	1-2	2-4 lb	Apply immediately after transplanting. If rain does not occur within 24 hours, incorporate it shallowly or irrigate with .5 inch of water.
		DCPA (DACTHAL 75W)	6-10.5	8-14 lb	Apply immediately after transplanting as a broadcast spray and again 6 weeks later at layby.
	Postemergence grasses	fluazifop-P (FUSILADE DX 2E)	0.16-0.19	10-12 fl oz	Apply to actively growing grasses. Include 1 qt COC/acre or 1 pt NIS/acre. 55-day PHI.
SWISS CHARD		sethoxydim (POAST 1.5E)	0.19-0.28	1-1.5 pt	Apply to actively growing grasses. Include 1 qt COC/acre. Maximum total of 5 pt/acre/year. 30-day PHI.
		clethodim (SELECT 2E)	0.125	0.5 pt	Apply to actively growing grasses. Make multiple applications to control perennial grasses. Do not exceed 2 pt/acre/year. Include 1 qt COC/acre. 30-day PHI.
	Emerged grasses	sethoxydim (POAST 1.5E)	0.19-0.28	1-1.5 pt	Apply to actively growing grasses. Include 1 qt COC/acre. Maximum total of 3 pt/acre. 30-day PHI.

TOMATO

Emerged weeds before crop emergence	paraquat (GRAMOXONE MAX 3L)	0.56-1	1.5-2.7 pt	Apply before transplanting or before or after seeding but before crop emergence. Include 1 pt NIS/100 gal. RUP.
Preemergence	napropamide (DEVINOL 50DF)	1-2	2-4 lb	SEEDED OR TRANSPLANTED. Apply before planting and incorporate 1-2 inches. Use low rate on light, sandy soils.
	trifluralin	0.5-1	1-2 pt	TRANSPLANTED. Apply before transplanting and incorporate 2 inches into the soil immediately. Use low rate on light, sandy soils.
	metribuzin (SENCOR 75DF)	0.25-0.5	0.33-0.66 lb	TRANSPLANTED. Apply before transplanting and incorporate 2-3 inches into the soil. Usually used in combination with trifluralin to improve preemergence broadleaf control.
Postemergence grasses	sethoxydim (POAST 1.5E)	0.19-0.28	1-1.5 pt	Apply to actively growing grasses. Include 1 qt COC/acre. Maximum of 4.5 pt total/acre. 20-day PHI.
	clethodim (SELECT 2E)	0.125-0.25	8-16 fl oz	Apply to actively growing grasses. Include 1 qt COC. Use high rate for perennial grasses and annual bluegrass. Maximum 32 oz/acre/year. 20-day PHI.
Postemergence emerged weeds	paraquat (GRAMOXONE MAX 3L)	0.56	1.5 pt	Use shields to protect crop. Apply in 20-30 gal water/acre. Do not exceed 30 PSI pressure. Do not allow spray to contact crop foliage. Maximum 3 applications per year.
Postemergence broadleaves	halosulfuron (SANDEA 75W)	0.023-0.047	0.5-1 oz	LABEL PENDING. TRANSPLANTED ON PLASTIC, for nutsedge suppression: apply to soil and then lay plastic. Wait 5 days before transplanting. TRANSPLANTED ON BAREGROUND: transplant tomato and wait 14 days before application. Apply over the top of transplants or directed between rows. POSTEMERGENCE: apply broadcast or directed to row middles to kill small weeds. Include 1 pt NIS/acre. Weak on nightshade. Maximum 2 oz/acre/year. 30-day PHI.
	metribuzin (SENCOR 75DF)	0.25	.33 lb	SEEDED OR TRANSPLANTED: Apply as a postemergence directed or broadcast spray to kill emerged broadleaves and extend preemergence control. Apply 0.33 lb product after tomatoes have 5-6 leaves. Apply after 3 warm, sunny days. Do not tank mix or spray within 1 day of other pesticides. Allow 14 days between applications. Use a maximum of 1 lb ai/acre/year pre- and postemergence. 7-day PHI.
Emerged perennials	rimsulfuron (MATRIX 25WDG)	0.031	2 oz	Apply to weeds less than 1 inch tall. Include .5 pt NIS/acre. Does not control nightshade. 45-day PHI.
	glyphosate (ROUNDUP 4L)	2-3	2-3 qt	SEEDED TOMATOES only. Apply to emerged perennials before planting the crop. Wait 3 days before planting. Check label for correct rate for each weed.

Crop	Weed Problem	Chemical	Lbs Active Ingredient/Acre	Product/Acre	Remarks and Limitations
WATERMELON	Emerging weeds before planting	paraquat (GRAMOXONE MAX 3L)	0.56-1	1.5-2.7 pt	Apply before seeding or transplanting melons to kill emerged weeds. Include 1 pt NIS/100 gal. RUP
	Preemergence	ethafluralin + clomazone (STRATEGY 2.1L)	0.6-1.2 0.19-0.375	3-6 pt	Apply to soil surface after seeding, or as a banded spray between rows after transplanting. Needs .5 inch water within 2 days for activation. Use lower rate on light soil.
		ethafluralin (CURBIT 3E)	0.75-1.13	2-3 pt	DIRECT-SEEDED MELONS: Use low rate on light, sandy soil. Apply to soil surface within 2 days of seeding. Do not incorporate. Needs 0.5 inch of rain or irrigation within 5 days to activate it. Heavy rainfall after application may cause crop injury. TRANSPLANTED MELONS: Apply to soil between rows of plastic mulch. Do not apply over or under row covers or plastic mulch. Do not spray over the top of transplants.
		clomazone (COMMAND 3ME)	0.15-0.25	0.4-0.67 pt	Apply to soil surface before transplanting or after seeding. Use low rate on coarse soils. 45-day PHI.
	bensulide (PREFAR 4E)	4-6	4-6 qt	Apply and incorporate 0.5-1 inch before seeding or transplanting. Controls many annual grasses. May stunt crop if used under clear plastic. Usually used in tank mix with Alanap.	
	naptalam (ALANAP 2L)	3-4	6-8 qt	PREEMERGENCE: Apply and incorporate before seeding or apply soon after seeding. Apply to moist soil or water in. Usually used in tank mix with Prefar. May be used under clear plastic. POSTEMERGENCE: Apply after transplanting or just before melons vine out. Controls several broadleaves.	
	trifluralin (TREFLAN 4E)	0.5-1	1-2 pt	Direct the spray between rows when plants have 3-4 leaves. Cultivate shallowly to incorporate. Avoid contact with crop leaves.	
	sethoxydim (POAST 1.5E)	0.19-0.28	1-1.5 pt	Apply to actively growing grasses. Include 1 qt COC/acre. Maximum total of 3 pt/acre/season. 14-day PHI.	
	clethodim (SELECT 2E)	0.125	0.5 pt	Apply to actively growing grasses. Make multiple applications to control perennial grasses. Do not exceed 2 pt/acre/year. Include 1 qt COC/acre. 14-day PHI.	
	glyphosate (ROUNDUP 4L)	2-3	2-3 qt	Apply to emerged perennials before planting the crop. Wait 3 days before planting.	
NON-CROP LAND AND SPECIAL WEED PROBLEMS	Bare ground—long-term control of annual and perennial weeds	diuron (KARMEX 80DF)	15-20	19-25 lb	For use around buildings, storage areas, fence rows, etc. Apply in spring before weeds emerge.
		hexazinone (VELPAR 90SP)	2-4.5	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 perennials. Do not use around shade trees or ornamentals.
		bromacil (HYVAR X 80W)	2.5-9	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.
		sulfometuron (OUST 75DG)	0.3-0.6	0.4-0.8 lb	Apply preemergence or early postemergence. Gives season-long control of most grasses and broadleaves. Avoid drift.
	oryzalin (SURFLAN 4L)	4-6	4-6 qt	Apply before weeds emerge. Controls most annual grasses and many broadleaves.	

Perennial broadleaves and grasses	glyphosate (ROUNDUP 4L)	2-4	2-4 qt	Apply to actively growing foliage. Check label for most susceptible stage of target weed.
	glyphosate (TOUCHDOWN 4L)	2-4	2-4 qt	Apply to actively growing foliage. Include 1 pt NIS/acre plus 3-4 lb ammonium sulfate in 10-30 gal water/acre.
	glufosinate (RELY 1 L)	1-1.5	4-6 qt	Apply to actively growing annuals and perennials. Gives quick burndown.
Emerged annuals	paraquat (GRAMOXONE MAX 3L)	0.56-1	1.5-2.7 pt	Apply to actively growing foliage. Include 1 pt NIS/100 gal. Can be used in combination with residual herbicides: RUP.
Emerged grasses	fluzifop-P (FUSILADE DX 2E)	0.25-0.38	1-1.5 pt	Apply to actively growing grasses. Use high rate on perennials and large annual grasses. Include 1 pt NIS or 1 qt COC/acre.
	sethoxydim (POAST 1.5E)	0.3-0.5	1.5-2.5 pt	Apply to actively growing grasses. Use high rate on perennials and large annual grasses. Include 1 qt COC/acre.
Annual broadleaves	2,4-D (several trade names and formulations)	1.5-3		Apply to actively growing foliage. Use amine or low-volatile ester formulations. Check label for amount of product/acre. Avoid drift to non-target areas.
Annual and perennial broadleaves	dicamba (BANVEL 4L)	0.25-2	0.25-2 qt	Controls many annual and perennial herbaceous weeds. Check label for rate for specific weeds. Prevent drift to non-target areas.
Yellow nutsedge	glyphosate (ROUNDUP 4L)	3-4	3-4 qt	Apply in 10-40 gal water/acre. Include 1 pt NIS/acre. Apply to actively growing nutsedge when at least 50% of the plants are in flower. Wait 7 days before tillage. Spot spray escapes 3-4 weeks later.
	bentazon (BASAGRAN 4L)	.75-1	.75-1 qt	Apply in 20-40 gal water/acre and at least 40 PSI. Include 1 qt COC/acre. Apply when plants are 6-8 inches tall. Make a second application 7-10 days later.
Brush control	dicamba (BANVEL 4L) 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 brush. Most effective during late spring and early summer.
	2,4-D+ triclopyr (CROSSBOW 3 lb/gal)	2+1	4 qt	Apply to actively growing herbaceous or woody plants. Controls most broadleaf species.
	triclopyr (GARLON) (4 lb/gal)	4-8	4-8 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.



The Vegetable Crop Advisory Team Alert Newsletter

Dependable pest management information from MSU Extension

The CAT Alert is MSU's targeted advice for growing vegetables

No one knows what the weather or pest situation will be this spring and summer. The Vegetable Crop Advisory Team (CAT) is structured to respond to the conditions with timely advice for growers and consultants. Members of the team are Extension field staff and campus faculty who meet weekly through conference phone calls to discuss current pest and crop conditions. Team members write newsletter articles and regional reports on crop development and pest management tactics for local conditions.

We cover immediate and long-term pest management tactics

The newsletter articles respond to current outbreaks and recommend long-term preventative actions. Our recommendations include resistance management and protecting beneficial organisms. Some of the subjects covered last year include:

- ◆ Finding nitrogen sources for your crops.
- ◆ How to manage crops in drought conditions.
- ◆ Dealing with diseases such as asparagus rust and Phytophthora crown rot.
- ◆ Controlling potato late blight.
- ◆ European corn borer trap catches.
- ◆ Pesticide regulations and registration changes including emergency registrations.
- ◆ Weather conditions, growing degree days, precipitation totals, and production implications.

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Our season begins April 2003. Most issues arrive during the growing season, but pre- and post- season issues address preventative measures and harvest or storage concerns. Send your subscription in any time during the year. We'll send back issues from the current publishing year, if you subscribe before July 1. **After July 1, the price is \$15 and does not include back issues.** Editions of the *CAT Alert* are also available for fruit, landscape, and field crops.

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Check the edition(s) you would like to receive:

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Enclose \$35 for each edition.

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Make your check payable to: **Michigan State University**. Send your check and this form to: CAT Alerts, B18 Food Safety & Toxicology Building, Michigan State University, East Lansing, MI 48824 (Phone: 517-353-4703)



PESTICIDE EMERGENCY INFORMATION

For any type of an emergency involving a pesticide, immediately contact the following emergency information centers for assistance.

Current as of February 2002



Human Pesticide Poisoning

POISON CONTROL

From anywhere in the United States, call

1 - 8 0 0 - 2 2 2 - 1 2 2 2

Special Pesticide Emergencies

Animal Poisoning

Your veterinarian:

Phone No.

or

Animal Health Diagnostic Laboratory (Toxicology) Michigan State University:

(517) 355-0281

Phone No.

and

Fire Marshal Division, Michigan State Police: M - F: 8-12, 1-5

(517) 322-1924

* **Telephone Number Operated 24 Hours**

Pesticide Fire

Local fire department:

Traffic Accident

Local police department or sheriff's department:

Phone No.

and

Operations Division, Michigan State Police:

*** (517) 336-6605**

Environmental Pollution

District Michigan Department of Environmental Quality (MDEQ) Office Phone No.

Phone No.

and

MDEQ Pollution Emergency Alerting System (PEAS):

***1-800-292-4706**

also

***1-800-405-0101**

Michigan Department of Agriculture Spill Response

Pesticide Disposal Information

Michigan Clean Sweep, Michigan Department of Agriculture Environmental Stewardship Division.

Monday - Friday: 8 a.m.-5 p.m.

(517) 335-6529

National Pesticide Information Center

Provides advice on recognizing and managing pesticide poisoning, toxicology, general pesticide information and emergency response assistance. Funded by EPA, based at Oregon State University
7 days a week; excluding holidays
6:30 a.m. - 4:30 p.m. Pacific Time Zone

1-800-858-7378

FAX: 1-541-737-0761