

F. Commodity Recommendations

Pesticide Use Disclaimer

THE LABEL IS THE LAW

Before using a pesticide, check the labeling distributed with the product at the point of sale for legally enforceable rates and use restrictions and precautions. Although labels are available on the Internet from electronic label services such as CDMS (<http://www.cdms.net/>), Greenbook (<https://www.greenbook.net/>), or Agrian (<https://www.agrian.com/labelcenter/results.cfm>) the information contained in these electronic labels may not be identical to the labeling distributed with the product. **Please be advised that these electronic label services provide use disclaimers, and in some cases legally binding *User Agreements* assigning all liability to user of service.** (See section D 3.1. Labels and Labeling for more detail.)

Guide to the Recommended Pesticide Tables in the Following Crop Sections:

1. Pesticides are listed by **group number or code based on chemical structure and mechanism of action**, as classified by the Herbicide Resistance Action Committee (**HRAC**, <https://hracglobal.com/>) for herbicides, the Insecticide Resistance Action Committee (**IRAC**, <https://irac-online.org/>) for insecticides, and the Fungicide Resistance Action Committee (**FRAC**, <https://www.frac.info/>) for fungicides.
In this guide, if the group number or code is in bold font, there are resistance concerns for the product.
2. **Restricted use pesticides** are marked with a * in the Tables. These products may only be used by certified and/or licensed pesticide applicators, and when stated on the label, those making applications under their direct supervision. Some labels may restrict use solely to certified and/or licensed applicators. (See section D 3.2.1 Restricted Use Classification Statement for more detail).
3. **In addition to the pesticide products listed in the Commodity Recommendations below, other formulations or brands with the same active ingredient(s) may be commercially available. ALWAYS CHECK THE INDIVIDUAL PRODUCT LABELING:**
 - a) to ensure a pesticide is labeled for the same intended use,
 - b) to ensure the pesticide is labeled for the desired crop,
 - c) for differences in application rates and % active ingredient(s), and
 - d) additional restrictions.
4. All pesticide recommendations contained in this document are prescribed for spray applications to a **broadcast area of 1 acre** (43,560 square feet). **Adjust the rate accordingly for banded applications** (See section E 1.3. Calibrating Granular Applicators) **or for chemigation** (check labels for amounts per 1,000 feet).
5. Check the label for and do not exceed the maximum amount of pesticide per application and the maximum number of applications per year.
6. **Bee Toxicity Rating (Bee TR):** N=nontoxic; L=minimum impact on bees; M=moderately toxic, can be used if dosage, timing, and method of application are correct, but should NOT be applied directly to the crop if bees are present; H=highly toxic, severe losses expected, -- = data not available.
7. In accordance with the USDA National Organic Program, the Organic Materials Research Institute (OMRI) maintains a directory of all products that OMRI has determined are allowed for use in organic production, processing, and handling. These products are catalogued online in the **OMRI Products List** (see <https://www.omri.org/omri-lists>).

Horseradish

Horseradish is a hardy perennial from the Mustard family that is grown for its fleshy white roots in annual production systems. Roots that are left in the ground for two or more growing seasons become stringy and woody. If roots are not harvested or killed, horseradish can become a weed.

There are three types of horseradish: “**Common**” types have broad crinkled leaves and high quality, large, smooth roots, but they are susceptible to virus and White Rust. “**Bohemian**” types have medium-sized narrow smooth leaves and somewhat lower quality roots. They are susceptible to virus but have some White Rust tolerance. “**Big Top Western**” types have smooth, large upright leaves and large, good quality roots; however, the roots are rough or corky on the surface. “Big Top Western” types have resistance to virus and White Rust. Use locally selected horseradish strains that are adapted to the area.

Recommended Nutrients Based on Soil Tests

In addition to using the table below, check the suggestions on rate, timing, and placement of nutrients in your soil test report and chapter B Soil and Nutrient Management. Your state’s soil test report recommendations and/or your farm’s nutrient management plan supersede recommendations found below.

Horseradish	N (lb/A)	Soil Phosphorus Level				Soil Potassium Level				Nutrient Timing and Method
		Low	Med	High (Opt)	Very High	Low	Med	High (Opt)	Very High	
		P ₂ O ₅ (lb/A)				K ₂ O (lb/A)				
1,2	150-200	200	150	100	0	200	150	100	0	Total nutrient recommended
	50	200	150	100	0	200	150	100	0	Broadcast and disk-in
	50-100	0	0	0	0	0	0	0	0	Sidedress 3-5 weeks after planting
	50	0	0	0	0	0	0	0	0	Sidedress 4-6 weeks after planting if needed

¹Apply 1.0 to 2.0 lb/A of boron (B) with broadcast fertilizer; see also Table B-7. in chapter B Soil and Nutrient Management.

²Apply 25-30 lb/A of sulfur (S) for most soils.

Planting and Spacing

Sets are selected roots from the previous crop. They should be 10-12 inches long and ¼ to 5/8 inch in diameter. Do not allow roots to dry out before planting. To ensure proper orientation at planting, make a square cut at the end of the roots nearest the main root. Make a slanting cut at the other end and plant the slanting cut end downward.

Plant in late April to early May. Place sets at an angle in a furrow so the top will be 1 inch deep and the bottom 2 inches deep. Alternatively, use a dribble to make a slanted planting hole, or leave several inches above the soil surface and cover sets by forming ridges in the row. Sets should point in the same direction that the cultivator will go, e.g., for two-row cultivator, two rows in one direction and the next two rows in the opposite direction. Space rows 34--36 inches apart with 18 inches between sets in the row.

Harvest and Storage

Dig roots as needed. In an annual system, the set will become the main root which is the largest and most valuable for market. For maximum growth, harvest once tops have died due to frost. Alternatively, tops can be cut off as close to the soil surface as possible. Then wait several days before harvesting. Roots overwinter, but winter soil conditions may prevent harvesting. Store horseradish in the dark with temperatures between 32-40°F (0-4°C) and 98% relative humidity. Roots exposed to light become green. Roots can be stored for 8-9 months. If storage and temperature conditions cannot be met, consider harvesting the following spring by digging the roots as soon as new growth starts to appear. Select the top performing lateral roots for the next crop

Weed Control

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Recommended Herbicides

1. Identify the weeds in each field and select recommended herbicides. More information is available in the “Herbicide Effectiveness on Common Weeds in Vegetables” (Table E-3) in chapter E Pest Management.
2. Minimize herbicide resistance development. Identify the herbicide mode of action group number and follow recommended good management practices; **bolded group numbers in tables below are herbicides at higher risk for selecting resistant weed populations.** Include non-chemical weed control whenever possible.

F. Horseradish

1. Preemergence						
Group	Product Name (*=Restricted Use)	Product Rate	Active Ingredient	Active Ingredient Rate	PHI (d)	REI (h)
3	Dacthal 6F Dacthal W-75	8 to 14 pt/A 6 to 14 lb/A	DCPA	6 to 10.5 lb/A	25	12
-Labeled for preemergence; incorporation is not recommended. -Labeled for applications over the top of transplants without injury (will not control emerged weeds). -Primarily controls annual grasses and a few broadleaf weeds, including common purslane. Results have been most consistent when used in fields with coarse-textured soils low in organic matter and when the application are followed by rainfall or irrigation. -Maximum application not addressed on label.						
14	Goal 2XL GoalTender 4F	2 pt/A 1 pt/A	oxyfluorfen	0.5 lb/A	--	48
-Apply immediately after planting but before emergence of new leaves. -Emerged leaves that receive direct herbicide application will be injured. It may be desirable to cultivate immediately prior to application to remove emerged weeds. Delay cultivation after Goal application, when possible, to reduce deactivation of Goal by incorporation. - Do not use Goal herbicide on horseradish plantings which are weak or under stress due to temperature, disease, fertilizer, nematodes, insects, pesticides, drought, or excessive moisture. - Do not apply more than 2 pt/A of Goal 2XL per crop or no more than 1 pt/A per crop of GoalTender.						
14	Zeus 4L or Spartan Charge 3.5EC	2.25 to 8 fl oz/A 2.9 to 10.2 fl oz/A	sulfentrazone	0.07 to 0.25 lb/A	--	12
-Labeled for pre-plant, preemergence or pre-plant incorporated. Do not incorporate to a depth greater than 2 inches. -Preemergence applications should be made at least 5 days prior to crop emergence. -Do not apply more than 8 oz/A per 12-month period. -Prepackaged mixtures with sulfentrazone include Authority Elite 7SE or BroadAxe 7SE: Authority Elite or BroadAxe at 25 fl oz = 21 fl oz Dual Magnum 7.62E + 5.3 fl oz of Spartan Charge.						
15	Dual Magnum 7.62E generic metolachlor 8EC	1 to 1.3 pt/A 1 to 2 pt/A	s-metolachlor metolachlor	0.95 to 1.27 lb/A 0.95 to 1.91 lb/A	--	24
-Apply after planting, but before crop emergence; Dual will not control emerged weeds. Primarily controls annual grasses, certain broadleaf weeds, and nutsedge. Do not make more than one application per crop; do not apply more than 1.33 pt/A per crop. -Prepackaged mixtures with s-metolachlor include Authority Elite 7SE or BroadAxe 7SE: Authority Elite or BroadAxe at 25 fl oz = 21 fl oz Dual Magnum 7.62E + 5.3 fl oz of Spartan Charge.						

2. Postemergence						
Group	Product Name (*=Restricted Use)	Product Rate	Active Ingredient	Active Ingredient Rate	PHI (d)	REI (h)
1	Select 2EC	6 to 8 fl oz/A	clethodim	0.07 to 0.125 lb/A	30	24
	Select Max 0.97EC	9 to 16 fl oz/A				
	Poast 1.5EC	1 to 2.5 pt/A	sethoxydim	0.2 to 0.3 lb/A	60	12
- Select 2EC : use crop oil concentrate (COC) at 1% v/v (1 gal/100 gal of spray solution). Select Max : use nonionic surfactant (NIS) at 0.25% v/v (1 qt/100 gal of spray solution). Poast : use COC at 1.0% v/v. - The use of COC may increase the risk of crop injury when hot or humid conditions prevail. To reduce the risk of crop injury, omit additives or switch to NIS when grasses are small and soil moisture is adequate. -Use lower labeled rates for annual grass control and higher labeled rates for perennial grass control. -Yellow nutsedge, wild onion, wild garlic, and broadleaf weeds will not be controlled. -Controls many annual and certain perennial grasses, including annual bluegrass, but Poast is preferred for goosegrass control. For best results, treat annual grasses when they are actively growing and before tillers are present. Control may be reduced if grasses are large or under hot or dry weather conditions. -If repeat applications are necessary, allow 14 days between applications. Rainfastness is 1 h. - Do not tank mix with or apply within 2 to 3 days of any other pesticide, unless labeled, as this may increase the risk of crop injury or reduce the control of grasses. - Do not apply more than 8 fl oz of Select 2EC in a single application and do not exceed 2 pt/A for the season; do not apply more than 16 fl oz of Select Max in a single application and do not exceed 4 pt/A for the season. - Do not apply more than 2.5 pt/A Poast in a single application and do not exceed 5 pt/A for the season.						
15	Outlook 6E	12 to 21 fl oz/A	dimethenamid	0.56 to 0.98 lb/A	40	12
-Apply postemergence from the 2-leaf to the 8-leaf stage. Outlook will not control emerged weeds. -Do not exceed the maximum labeled for the soil type.						

3. Other Labeled Herbicides These products are labeled but limited local data are available; and/or are labeled but not recommended in our region due to potential crop injury concerns.						
Group	Product Name (*=Restricted Use)	Active Ingredient				
7	Lorox	linuron				
14	Aim	carfentrazone				

Insect Control

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Recommended Insecticides

Aphids

Apply one of the following formulations:						
Group	Product Name (* = Restricted Use)	Product Rate	Active Ingredient(s)	PHI (d)	REI (h)	Bee TR
1A	Lannate LV*	1.5 pt/A	methomyl	65	48	H
1B	Malathion 57 EC	1.0 to 2.0 pt/A	malathion	7	24	H
4A	Actara 25WDG	1.5 to 3.0 oz/A	thiamethoxam	7	12	H
4A	Admire Pro	4.4 to 10.5 fl oz/A	imidacloprid – soil	21	12	H
4A	Admire Pro	1.2 fl oz/A	imidacloprid – foliar	7	12	H
4A	Platinum 75SG	1.7 to 4.01 oz/A	thiamethoxam	AP	12	H
4D	Sivanto Prime or 200 SL	7.0 to 14.0 fl oz/A	flupyradifurone	7	4	M
29	Beleaf 50SG	2.0 to 2.8 oz/A	flonicamid	3	12	L

Beet Leafhoppers Beet leafhoppers can vector brittle root pathogen, and treatment may be justifiable if beet leafhoppers are present by late July.

Apply one of the following formulations:						
Group	Product Name (* = Restricted Use)	Product Rate	Active Ingredient(s)	PHI (d)	REI (h)	Bee TR
1A	Sevin XLR Plus	0.5 to 1.0 qt/A	carbaryl	7	12	H
3A	Fastac CS*	1.8 to 3.8 fl oz/A	alpha-cypermethrin	1	12	H
4A	Actara 25WDG	1.5 to 3.0 oz/A	thiamethoxam	7	12	H
4A	Admire Pro	4.4 to 10.5 fl oz/A	imidacloprid – soil	21	12	H
4A	Admire Pro	1.2 fl oz/A	imidacloprid – foliar	7	12	H
4A	Platinum 75SG	1.7 to 4.01 oz/A	thiamethoxam	AP	12	H
4D	Sivanto Prime or 200 SL	7.0 to 14.0 fl oz/A	flupyradifurone	7	4	M

Cutworms See also section E 3.1. Soil Pests - Detection and Control.

Cutworms are moth larvae (caterpillars) that feed on roots and stems. They chew on stems at or near the soil line, severing young plants. Larvae are typically active at night and spend most of this stage belowground. Cutworms are favored by less disturbed soils and debris covered soil surfaces. Conventional tillage and soil incorporation of crop debris helps reduce populations. Several species are capable of causing injury to young plants. There are usually 2 generations per season. If cutworm damage is anticipated, it is best to treat preventively.

Apply the following formulations:						
Group	Product Name (* = Restricted Use)	Product Rate	Active Ingredient(s)	PHI (d)	REI (h)	Bee TR
3A	Brigade 2EC*	5.1 to 6.4 fl oz/A	bifenthrin	21	12	H
3A	Hero EW*	2.6 to 6.1 fl oz/A	bifenthrin + zeta-cypermethrin	21	12	H
3A	Mustang Maxx*	1.28 to 4.0 fl oz/A	zeta-cypermethrin	1	12	H

Flea Beetles (FB), Harlequin Bugs

Apply one of the following formulations:						
Group	Product Name (* = Restricted Use)	Product Rate	Active Ingredient(s)	PHI (d)	REI (h)	Bee TR
1A	Sevin XLR Plus (not labeled for harlequin bug)	1.0 qt/A	carbaryl	7	12	H
3A	Brigade 2EC*	6.4 fl oz/A	bifenthrin	21	12	H
3A	Hero EW*	2.6 to 6.1 fl oz/A	bifenthrin + zeta-cypermethrin	21	12	H
3A	Mustang Maxx*	1.76 to 4.0 fl oz/A	zeta-cypermethrin	1	12	H
3A	Fastac CS*	1.8 to 3.8 fl oz/A	alpha-cypermethrin	1	12	H
3A + 28	Elevest* (FB only)	7.7 to 9.6 fl oz/A	bifenthrin + chlorantraniliprole	21	12	H
4A	Actara 25WDG	1.5 to 3.0 oz/A	thiamethoxam	7	12	H
4A	Admire Pro	10.5 fl oz/A	imidacloprid – soil	21	12	H
4A	Admire Pro	1.2 fl oz/A	imidacloprid – foliar	7	12	H

Flea Beetles (FB), Harlequin Bugs - continued next page

F. Horseradish

Flea Beetles (FB), Harlequin Bugs - continued

Group	Product Name (*=Restricted Use)	Product Rate	Active Ingredient(s)	PHI (d)	REI (h)	Bee TR
4A	Platinum 75SG	1.7 to 4.01 oz/A	thiamethoxam	AP	12	H
5	Blackhawk 36WG (FB only)	1.7 to 3.3 oz/A	spinosad	3	4	M
5	Entrust SC (OMRI) (FB only)	4.0 to 10.0 fl oz/A	spinosad	3	4	M
5	Radiant SC (FB only)	5.0 to 6.0 fl oz/A	spinetoram	3	4	M
28	Exirel (FB only)	13.5 to 20.5 fl oz/A	cyantraniliprole	1	12	H

Imported Cabbageworm, Diamondback Moth, Cabbage Looper, and Armyworm spp.

Early season infestations rarely warrant control because the plant can outgrow injury unless injury to the growing point prevents new leaf emergence. Mid-season defoliation thresholds are greater than 30% defoliation and defoliators are abundant.

Apply one of the following formulations:						
Group	Product Name (*=Restricted Use)	Product Rate	Active Ingredient(s)	PHI (d)	REI (h)	Bee TR
1B	Malathion 57 EC	1.0 to 2.0 pt/A	malathion	7	24	H
3A	Brigade 2EC*, others	5.1 to 6.4 fl oz/A	bifenthrin	21	12	H
5	Blackhawk 36WG	1.7 to 3.3 oz/A	spinosad	3	4	M
5	Radiant SC	6.0 to 8.0 fl oz/A	spinetoram	3	4	M
5	Entrust SC (OMRI)	3.0 to 6.0 fl oz/A	spinosad	3	4	M
11A	XenTari (OMRI)	0.5 to 1.5 lb/A	<i>Bacillus thuringiensis aizawai</i>	0	4	N
11A	Dipel DF, others (OMRI)	0.5 to 2.0 lb/A	<i>Bacillus thuringiensis kurstaki</i>	0	4	N
18	Intrepid	8.0 to 16.0 fl oz/A	methoxyfenozide	1	4	L
18 + 5	Intrepid Edge	4.5 to 12.0 fl oz/A	methoxyfenozide + spinetoram	7	4	M
28	Coragen 1.67SC	3.5 to 7.5 fl oz/A	chlorantraniliprole - foliar	1	4	L
28	Vantacor	1.2 to 2.5 fl oz/A	chlorantraniliprole - foliar	1	4	L
28 + 3A	Elevest*	5.6 to 9.6 fl oz/A	chlorantraniliprole + bifenthrin	21	12	H

Imported Crucifer Weevil

Apply one of the following formulations:						
Group	Product Name (*=Restricted Use)	Product Rate	Active Ingredient(s)	PHI (d)	REI (h)	Bee TR
3A	Permethrin 3.2EC*	6.0 fl oz/A	permethrin - foliar	30	12	H
3A	Permethrin 3.2EC*	17 fl oz/100 gal	permethrin - pre-plant dip	30	12	H

Thrips

Apply one of the following formulations:						
Group	Product Name (*=Restricted Use)	Product Rate	Active Ingredient(s)	PHI (d)	REI (h)	Bee TR
1A	Lannate LV*	1.5 pt/A	methomyl	65	48	H
4A ¹	Admire Pro	4.4 to 10.5 fl oz/A	imidacloprid - soil	21	12	H
5	Entrust SC (OMRI)	4.0 to 10.0 fl oz/A	spinosad	3	4	M
5	Radiant SC	6.0 to 8.0 fl oz/A	spinetoram	3	4	M
5	Blackhawk 36WG	1.7 to 3.3 oz/A	spinosad	3	4	M

¹Resistance concerns with tobacco thrips

Disease Control

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Recommended Fungicides

Damping-off caused by *Phytophthora*, *Pythium*, and *Rhizoctonia*

Code	Product Name (*=Restricted Use)	Product Rate	Active Ingredient(s)	PHI (d)	REI (h)	Bee TR
Apply one of the following at planting (see label for application methods and restrictions):						
Phytophthora and Pythium root rot						
4	Ridomil Gold 4SL	0.5 to 1.0 pt/A	mefenoxam	5	48	N

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Damping-off - continued

4	Ultra Flourish 2E	2.0 to 4.0 pt/A	mefenoxam	5	48	N
4	MetaStar 2E AG	4.0 to 8.0 pt/A	metalaxyl	AP	48	N
Phytophthora, Pythium, and Rhizoctonia root rot						
4 + 11	Uniform 3.66SE	0.34 fl oz/1000 ft row. Avoid direct seed contact, which may cause delayed emergence.	mefenoxam + azoxystrobin	AP	0	N
Rhizoctonia root rot						
11	azoxystrobin 2.08F	0.40 to 0.80 fl oz/1000 ft row	azoxystrobin	AP	4	N

Bacterial and Fungal Diseases**Bacterial Leaf Spot**

Rotate away from cruciferous crops for at least 2 years if the field has a known history of disease. Avoid excessive irrigation and maintain proper drainage. Avoid cultivation or other activity when foliage is wet to minimize spread.

Leaf Spots caused by *Alternaria* and *Cercospora* spp.

Use resistant cultivars where available. A 3-year rotation to non-cruciferous crops may be required if the field has a history of disease.

Code	Product Name (* = Restricted Use)	Product Rate	Active Ingredient(s)	PHI (d)	REI (h)	Bee TR
When conditions favor disease development, apply one of the following on a 7-14 d schedule and rotate between fungicides with different FRAC codes as long as weather conditions favor disease development:						
7	Endura 70W	4.5 oz/A (<i>Alternaria</i> only)	boscalid	0	12	--
7	Fontelis 1.67SC	16.0 to 30.0 fl oz/A	penthiopyrad	0	12	L
7 + 12	Miravis Prime	6.8 fl oz/A	pydiflumetofen + fludioxonil	7	12	--
11	azoxystrobin 2.08F	6.2 to 15.5 fl oz/A	azoxystrobin	0	12	N
11	Cabrio 20EG	8.0 to 16.0 oz/A	pyraclostrobin	0	12	N

Ramularia Stem and Leaf Spot

In fields with a known history of *Ramularia* stem and leaf spot apply the following preventatively or when conditions favor disease development.

Code	Product Name (* = Restricted Use)	Product Rate	Active Ingredient(s)	PHI (d)	REI (h)	Bee TR
M05	chlorothalonil 6F	3.0 pt/A	chlorothalonil	14	12	N

Verticillium Wilt

Rotate away from fields with a known history of *Verticillium* Wilt. Carefully inspect planting stock for discoloration, streaking and internal flecking. Plant only healthy planting material.

White Rust

Use certified, disease-free seed. A rotation to non-cruciferous crops may be required if the field has a history of disease. Manage weeds and volunteer hosts which may act as reservoirs for the pathogen. Plant "Big Top Western" types which have virus and White Rust resistance.

Code	Product Name (* = Restricted Use)	Product Rate	Active Ingredient(s)	PHI (d)	REI (h)	Bee TR
When conditions favor disease development, apply one of the following on a 7 to 14-day schedule:						
11	azoxystrobin 2.08F	6.2 to 15.5 fl oz/A	azoxystrobin	0	12	N
11	Cabrio 20EG	8.0 to 16.0 oz/A	pyraclostrobin	0	12	N

If you are having a medical emergency after using pesticides, call 911 immediately.

If you have any of the following symptoms during or shortly after using pesticides: headache, blurred vision, pinpoint pupils, weakness, nausea, cramps, diarrhea, and discomfort in the chest, call a physician and the National Poison Control Center hotline (1-800-222-1222).

Your call will be routed to your State Poison Control Center.

Anyone with a pesticide exposure poisoning emergency can call the toll-free telephone number for help. Personnel at the Center will give you first-aid information and direct you to local treatment centers if necessary.

For immediate medical attention call 911. Prompt action and treatment may save a life.



In Case of an Accident

- Remove the person from exposure.
- Get away from the treated or contaminated area immediately.
- Remove contaminated clothing.
- Wash with soap and clean water.
- Call a physician and the Poison Control Center (1-800-222-1222) or agency in your state.
- **Have the pesticide label with you! Follow the First Aid Precautionary Statements.**
- Be prepared to give the EPA registration number to the responding center/agency.