Crop Profile for Carrots in Minnesota

Prepared Dec., 2001

General Production Information

Minnesota produces approximately 2000 acres of carrots annually; 1000 ac. of fresh market carrots and an additional 1000 ac. of processing carrots (15). Nationally, 67% of the carrot crop is destined for fresh market and 33% is processed. Average yield for Minnesota carrot producers in 2000 was 17.8 tons/ac. with a value of $65.10/ton (9).

Production Regions:
The majority of carrots are produced in southeast and central Minnesota with Anoka (539 ac.), Freeborn (486 ac.) and Marshall (224 ac.) counties leading the state in harvested acreage in 1997 (13).

Cultural Practices

Although carrots tolerate different soil types, they grow best in sandy, sandy-loam, or organic soils. Ideal carrot producing soils are uniform and well drained. Compacted soils will result in misshapen and deformed roots. Acidic soils with pH of 5.5-7.0 tend to produce greater yields than alkaline soils (7). Carrots grow best in cool weather and the roots attain optimal color with temperatures of 60-70° F. The deep orange color develops rapidly when temperatures are within this range about a month prior to harvest but diminishes when the temperature is higher(8).

A uniform water supply is essential for good root color and formation. Carrots are most sensitive to moisture stress during seed germination and root enlargement. Irrigation improves emergence, reduces soil erosion via wind and

decreases soil temperature at the soil line during germination. Uneven soil moisture levels during root growth can result in small, woody, and poorly flavored carrots. Irregular watering can also cause rough, lumpy carrots with obvious growth rings and applying water after the carrots have suffered moisture stress may cause growth cracks and poor coloration. Carrots require 10-15 inches of water applied evenly over the 3-4 month production period (7).

Carrots use significant nutrients and nutrient availability must be sufficient to support the crop. A soil test including soil type and the previous crop history will provide the most accurate guide to fertilizer requirements for a given field. Nitrogen is a key nutrient for carrot growth. For nitrogen, the suggested method of application is to broadcast and incorporate ½ the total required before planting. The remaining nitrogen can be applied as a sidedress application once the plants are established. Other nutrients can be incorporated into the soil prior to seeding. If banding equipment is available, some the fertilizer can be applied at planting (7).

Petiole sampling can be used during the growing season to monitor the nutrient status of the carrots and to diagnose nutritional problems. The nutrients (and ranges) in the most recently mature leaves from an adequately fertilized crop include: N (1.8-2.5%); P (0.2-0.4%); K (2.0-4.0%); Ca (2.0-3.5%); Mg (0.2-0.5%); Fe (30-60 ppm); Mn (30-60 ppm); Zn (20-60 ppm); B (20-40 ppm); and Cu (4-10 ppm).

Fields can be direct-seeded from early April-July in Minnesota. Carrot seed is small in comparison to many vegetable seeds, and emergence is slow; germination may take as long as 10 days in cool weather. Carrot seeds should be treated with a fungicide to prevent damping off prior to emergence. Carrot seeds are sown at an average rate of 1 million seeds/ ac. with fresh market varieties being planted at higher rates and the larger processing types at lower rates. Seed densities up to 1.2 million seeds/ac. are used in plantings for the 'cut and peel' market.

Both natural and pelleted seed is used. For natural seed, many growers use converted Planter Jr. planters that utilize a random flow distribution of seed drop. Precision seeders (e.g., Stanhay belt planters) with split shoes are often used for pelletized seed. Other precision planters used by carrot growers include Gespardo and Stanhay vacuum planters.

Most carrots are harvested with self-propelled multirow harvesters, which undercut and lift carrots from the ground by their tops using a system of belts. After the tops are sheared off, roots are dropped into a waiting truck running alongside the harvester. For the fresh market, roots are hauled to a shed for washing, grading, sizing, and packing. Overall, 40-80% of all carrots in a field are harvested and packed; those that are damaged by insects, diseases, or are deformed, cracked, or off-color are culled. Large processing carrots are typically topped and crowned in the field before harvesting with a Coulter pick-up or modified potato harvester. Carrots in a small percentage of the acreage are hand bunched with the tops intact.

Wherever carrots are grown, a variety of diseases, insects, and weeds reduce both the yield and the market value of the roots. Bunching carrots must have insect and damage-free tops and roots. While tops are not an issue for bulk, cello-packed, or lightly processed carrots (e.g., 'cut and peel'), healthy tops are critical for harvest since the undercut carrots are handled by the leaves. The presence of heavy weed infestations also causes inefficient harvesting. Controlling and managing insect, disease and weed pests is extremely important for optimal carrot production.

Insect Pests

Relatively few insects cause problems in carrots. Aster leafhoppers are an annual problem and can cause the most economic damage because they vector aster yellows, a phytoplasma-like organism (16, 17). Aphids and cutworms are sporadic pests in most years while the carrot weevil is a pest in limited areas (6).

Aster Leafhopper (*Macrosteles quadrilineatus*)

The aster leafhopper (ALH) is the most serious economic pest of carrots because it serves as a vector for aster yellows. ALH adults are 1/6-1/8 inch long, light green-yellow, wedge-shaped insects. The ALH acquires aster yellows when extracting phloem from infected hosts during feeding. More than 150 plants serve as potential hosts for aster yellows, including: lettuce, celery, endive, and parsnip. Common weed hosts include: thistle, fleabane, wild lettuce, sow thistle, chicory, wild carrot, galinsoga, dandelion, plantain, and cinquefoil. After feeding on an infected host, the pathogen incubates in the leafhopper for at least three weeks before the ALH can transmit the pathogen to another plant during feeding. Some ALH survive Midwestern winters in the egg stage on winter grains but the majority of ALH in the upper Midwest migrate from southern states in early spring. Migratory ALH may have the disease when they arrive whereas local ALH need at least three weeks to incubate the aster yellows pathogen.

The aster yellows disease attacks phloem cells and restricts the transport of photosynthetic products to other plant parts. Initial symptoms include chlorotic leaves, eventually appearing red or purple in color. Additionally, petioles become twisted and/or dwarfed as the carrot top develops a dense growth of shoots or ‘witches’ broom’. The root is also damaged as the root develops a dense, hairy growth of secondary roots and acquires bitter taste. Roots also become susceptible to the invasion of soft rots both in the field and in storage (6, 9).

Pest management programs for aster yellows focuses on developing resistant varieties and controlling the leafhopper vector. Insecticides such as esfenvalerate, methoxychlor, and cyfluthrin provide the most consistent control of the aster leafhopper. The timing of an insecticide application is more important than the rate in controlling the leafhopper. The effectiveness of an insecticide spray is dependent knowing the leafhopper migration patterns and the percentage of the leafhopper population infected with aster yellows. In addition, some cultivars are more resistant to aster yellows. The University of Wisconsin developed an aster yellows index (AYI) that incorporates the infectivity of the current year’s leafhopper population based on sampling and the varietal tolerance to aster yellows in carrots. The action threshold is 40 leafhoppers/100 sweeps, 30/100 sweeps for intermediate cultivars, and 20/100 sweeps for susceptible cultivars. Due to the extended incubation period of the aster yellows pathogen within the aster leafhopper, growers can stop spraying for aster leafhopper three weeks before harvest. In addition to chemical controls and resistant varieties, removal or reduction of infected carrots and other hosts may also helps to reduce the spread of aster yellows (6,10,16,17).

Aphids

Several aphid species are pests of carrots but the green peach aphid is the most common. Nymphs have green spots and posses black cornicles while adults can vary from pale green to pink. These aphids produce live young throughout the summer without mating and overwinter as eggs on woody shrubs and migrate to crops in late spring. Most aphid damage is caused to young carrots when aphids feed on young, growing plant tissue. Carrot leaves will often become yellow and wilt and the distorted growth of roots and shoots often results (6,10).

Insecticides sprayed to control aster leafhoppers also generally control aphids. Aphids have many natural enemies such as lady beetle adults and larvae, green lacewing larvae, syrphid larvae, and parasitic wasps that also help to control aphids. Aphid and aster leafhopper population levels can be monitored at the same time using a sweep net. If aphids are found, at least 50 carrot plants should be inspected. Although economic thresholds have not been determined, treatments are generally applied when >25% of the plants are infested (6,10).

Cutworms *(Agrotis ipsilon)*

Several cutworm species occasionally infest carrots in Minnesota. The black cutworm (*Agrotis ipsilon*) causes the most damage because it arrives before other species and at a time when carrots are typically most vulnerable to damage. Black cutworm adults, nocturnal flyers, migrate from southern states during the spring to lay their eggs. Adults are gray-

colored moths with a series of distinct dark markings on their forewings and lighter colored hind wings. The black cutworm can lay up to 1000 eggs singly or in small groups on leaves and stems of weeds, often in low spots in fields. Larvae can reach nearly 2 inches in length once they reach their terminal instar and are light gray-black in color with faint, lighter stripes. The tubercles or bumps on each segment are unequal in size. Larvae remain hidden in the soil during the day and emerge at night to feed on plant tissue. Larger larvae may chew holes in seedling leaves and even defoliate plants. When the larvae reach ½ inch in length, they may completely sever the seedling at or just below the soil surface. Of the several generations in Minnesota annually, the first is the most destructive because plants are more susceptible when small (6). Black cutworms prefer to lay their eggs on grasses, so good weed control may help to prevent or minimize cutworm infestations. Insecticide treatments are generally applied when >25% of the plants are infested (5, 6).

Carrot Weevil (*Listronotus oregonensis*)

The carrot weevil is an occasional pest in the upper Midwest. Adult weevils are stout, dark brown beetles approximately ½ inch long. Adults overwinter in the soil or in plant debris. When the adults emerge in spring, females lay eggs in the small holes gouged out of carrot foliage. Larvae hatch 1-2 weeks later and burrow into carrot roots or foliage to feed. The larvae are bluish-white in color with reddish-brown heads. Although adult weevils may feed on carrot foliage, larvae feeding on root tissue causes most of the damage (6, 11).

Traps baited with carrot can be used to detect the presence of carrot weevil. Carrot pieces are placed under a mesh screen to prevent other animals from eating them and placed near ditch banks, tree lines, or other potential overwintering sites. Adults are attracted to the carrots and females lay eggs in the petioles or root tops. Examining the traps every 3-4 days for the presence of eggs in the spring will indicate if weevils are active and the extent of the infestation. Carrot weevils are easily managed by treating on a 3-5 day schedule for 2 weeks once eggs have been found. Additionally, carrot weevils do not move far from overwintering sites to lay eggs, so crop rotation is another tool for management (6).

Control Options:

Organic/Alternative:
Potassium salts of fatty acids (M-Pede) M-Pede is labeled for aphids. The products must contact the aphids to be effective. The labeled rate is 1-2% product volume/water volume. There is a 12-hr REI and a 0-day PHI.

Insecticides:

Carbamates

- Carbaryl (Sevin XLR Plus) Sevin can be used to control leafhoppers. There is a 12-hour REI for Sevin and a 7 day PHI. The labeled rate for Sevin XLR Plus is 1 qt/A.
- Oxamyl (Vydate) *RUP. Vydate is labeled for use on carrot weevils. The labeled rate is 2-4 pts/A. There is a 48 hr REI and a 14 day PHI.

Pyrethroids

- Esfenvalerate (Asana XL) *RUP. Asana XL is labeled for use on carrots to control leafhoppers, cutworms, and carrot weevils. The labeled rate is 5.8-9.6 fl. oz/ per acre, not to exceed 96 oz/A per season. There is a field REI of 12 hours and a 7 day PHI.
- Cyfluthrin (Baythroid 2E) *RUP. Baythroid is labeled for use on carrots to control leafhoppers, cutworms, and carrot weevils. The labeled rate is 1.6-2.8 oz/A not to exceed 5 applications per year with an interval of at least seven days between applications. There is a field REI of 12 hours and a 0- day PHI.

Organophosphates

- Diazinon (Diazinon 50WP) *RUP. Diazinon can be used to control aphids. The product is applied at a rate of 1 lb/A. There is a field REI of 12 hours and a 14 day PHI.

Organochlorines

- Endosulfan (Thiodan 3EC). *RUP. Thiodan is labeled for use on aphids. The product is applied at a rate of 0.7-1.3 qt/A not to exceed 1.3 qts/A/season. There is a field REI of 24 hours and a 7-day PHI.

Chlorinated hydrocarbon

- Methoxychlor (Methoxychlor 2EC). Methoxychlor is labeled for use on leafhoppers. The product is applied at a rate of 2-4.5 qt/A. There is a field REI of 12 hours and a 14 day PHI.

Table 1. Insect control options: chemical products

Foliar Products	Field rate	A.I. rate	PHI/REI	Application schedule	Remarks
Natural					
M-Pede	1-2% v/v	50% of volume	0 d 12 h	Repeat at 1-2 week intervals	Aphids & leafhoppers. Must contact insects to be effective, tank mix with Thiodan or Orthene for aphid suppression
Carbamates					
Sevin XLR Plus	1 qt/A	1 lb/A	7 d 12 h	3+ d	Leafhoppers. Treat field margins for best control
Vydate	2-4 pts/A	0.5-1 lb/A	14 d 48 h	3 apps. max at 2-3 week intervals.	Carrot weevil; total ≤136 oz/A/Yr (4 lb AI/A/Yr)
Pyrethroids					
Asana XL	5.8-9.6 oz/A	0.03-0.05 lb/A	7 d 12 h	3+ d	Leafhoppers, cutworms, carrot weevils; total ≤96 fl. oz/A/Yr.
Baythroid 2E	1.6-2.8 oz/A	0.03-0.04 lb/A	0 d 12 h	As needed.	Leafhoppers, cutworms, carrot weevils; total ≤5 apps./Yr; allow 7 d between apps.

Organophosphates					
Diazinon 50WP	1 lb/A	0.5 lb/A	14 d 12 h	7 d	Aphids
Organochlorines					
Thiodan 3EC	0.7-1.3 qt/ A	0.5-1 lb/A	7 d 24 h	As needed	Aphids; total ≤1 lb AI/ A/Yr
Chlorinated hydrocarbon					
Methoxychlor 2EC	2-4.5 qts/ A	2-2.25 lbs/A	14 d 12 h	7-14 d	Leafhoppers

Diseases

The frequency of occurrence of the following diseases is highly dependent on the weather, soil moisture, and other environmental factors encountered throughout the growing season (1,4).

Fungal Diseases

Alternaria leaf blight (*Alternaria dauci*)

Alternaria is a leaf blight disease. During periods of wet weather, conidia on leaves and crop debris sporulate and disseminate through wind currents. When the spores land on susceptible tissue, they either enter the plant through wounds or directly penetrate the plant tissue. The disease tends to start on older leaves because the denser canopy provides a more humid environment. Dark brown spots form on leaves and may coalescence. Depending on environmental conditions, the conidia on the lower leaves may spread up to the younger leaves. Spots may also develop on the petioles and stems, often girdling the stems. The leaves may have so many spots that the leaves appear dried up. If enough foliage is damaged, carrot roots develop poorly. Moreover, the lack of strong foliage hampers the mechanical harvester form pulling the carrots from the soil. Some spores may drop into the soil and infect the roots. If the roots are infected, dark lesions develop.

Crop sanitation and crop rotation are the cultural methods of control. Resistant cultivars are also available. In some cases, however, preventive fungicides are often needed to control the disease.

Cercospora leaf spot/blight (*Cercospora carotae*)

Cercospora is another leaf blight. The early leaf spots often appear along the leaf margins, often causing the leaves to curl. The spots in the center of the leaves are small, brown, and irregularly circular to angular. The centers of the spots often turns gray or tan and become papery thin. The leaf tissue may eventually drop out of the center. Sometimes the spots coalesce to form large necrotic areas. The leaves may become so damaged that they fall off. Dark brown lesions with tan to gray centers may also develop on the petioles and stems. The lesions may merge, girdle the stem, and cause the stem to collapse. Cercospora needs some wetness to sporulate; a heavy dew is often sufficient. Moreover, Cercospora

thrives in hot, humid weather in contrast to Alternaria which prefers cooler temperatures.

Cultural controls consist of cleaning up crop debris; the spores can survive up to three years on debris. Preventive fungicides are often needed to control the disease.

Downy Mildew (*Peronospora spp.*)

Downy mildew sometimes attacks carrots during in moist, cool conditions. The infection may appear as lesions on the leaves and may eventually become systemic. The lesions are yellow and brown irregular areas on the upper leaf surface with a grayish white, fluffy growth on the underside of the leaves. The infections tend to move from the bottom foliage and progress up the plant. Downy mildew tends to attack young tissue. The extent of the damage in a field is dependent on the length of the period of continued wetness.

Spores are spread between plants through air currents and splashing water. The fungus overwinters as resting spores in plant debris left in the fields. Thus, the best control is to remove all infected crop debris. There is no effective chemical control

White mold or Cottony soft rot *(Sclerotinia sclerotiorum)*

White mold attacks many plant species, often during wet, cold conditions. When white mold attacks carrots, spores often first infect the base of the foliage and then moves down into the root. An extensive mat of white, cottony growth develops on the root. The diseased root tissue looks darker than the healthy tissue and then becomes watery and soft. Unfortunately, the foliage may look normal while the infection invades the roots. Eventually, however, the foliage turns yellow, wilts, and collapses. The foliar symptoms can be mistaken for other rot diseases. White mold can also infect carrots during storage. Spores can remain dormant in the soil as dark sporangia for a number of years. Under the cold, wet conditions, the sclerotia germinate to form cup-shaped bodies that release spores into the air. Airborne spores typically colonize senescent plant tissue. The spores either enter the stomata or directly penetrate plant tissue to establish a mycelium colony. Spores are also spread mechanically to other plants through the movement of machinery, animals, or people. In addition, spores are transmitted through irrigation water.

Since white mold is primarily a soil borne fungus, rotating to non-susceptible crops for three years reduces the amount of dormant spores in the soil.

Control Options:(5)

Cultural practices:

Crop rotation:
A 3-4 year crop rotation helps to control Alternaria leaf, blight, Cercopsora leaf blight, downy mildew, and white mold. Many disease pathogens overwinter in soil debris. Crop rotation helps to eliminating the fungal inoculum associated with the crop debris of specific species.

Conventional Fungicides:

Seed treatments:
Captan or Thiram are used as seed treatments to prevent damping off. The chemicals are applied to seeds before planting.

Foliar treatments:

- *Chlorothalonil (Bravo, Terranil, Echo)* are applied to control Alternaria leaf blight and Cercospora leaf blight. Products are applied at rates of 1.5-4.5 pts/A (flowable formulations). There is a field REI of 48 hours and a 0 day PHI.
- *Iprodione (Rovral)* is applied to control Alternaria leaf blight. The product is applied at a rate of 1-2 pt/A (flowable). There is a field REI of 24 hours and a 0 day PHI.
- *Azoxystrobin (Quadris)* is applied to control Alternaria leaf blight. The product is applied at a rate of 9.2-20.3 oz/A. There is a field REI of 4 hours and a 0 day PHI.

Table 2. Disease control options: chemicals

Foliar Product	Field Rate	A.I. Rate	PHI/ REI	App. Sched.	Remarks
Bravo	Flowable: 2.25-2.75 pt/A	1.17-1.43 lbs/A	0 d 48 hr.	7-10 d.	Alternaria & Cercospora leaf blight.
Echo	1.5-2 pts/A	1.1-1.5 lbs/A	0 d 48 h	7-10 d	Alternaria & Cercospora leaf blight; <15 lbs/AI/Ac/Yr
Terranil Cu	3.4-4.5 pts/A	1.6-2.2 lbs/A	0 d 48 h	7-10 d	Alternaria & Cercospora leaf blight
Rovral	Flowable: 1-2 pt/A	0.13-0.25 lbs/A	0 d 24 h	7-14 d	Alternaria & Cercospora leaf blight: total ≤4 apps./yr
Quadris	9.2-20.3 oz/A	0.15-0.33 lb/A	0 d. 4 h	7-14 d	Early and late blight, Alternaria & powdery mildew; apply <2 lbs/ AI/A/Yr and <7 apps/Ac/Yr

Nematodes

Root-knot nematodes (*Meloidogyne hapla*) are tiny, plant parasitic, worm-like organisms found in many soils. They damage plants by causing bulges and swellings on carrot roots; the distorted roots are unmarketable. Nematodes also deprive carrots of nutrients necessary for normal development. Affected roots are smaller and have reduced growth and the foliage turns yellow and is smaller than normal. If the root-knot nematodes attack seedlings, the entire crop may be destroyed. Nematode treatments include methyl bromide, sodium methyl dithiocarbamate, or Vydate-L. Methyl bromide and sodium methyl dithiocarbamate provide the best results when nematode populations are moderate-high while Vydate-L provides adequate control when populations are low-moderate. Field sampling for root-knot nematodes should take place before planting; fields with high numbers of nematodes should be avoided (1, 5).

Weeds

Weeds compete with carrots for light, nutrients, and water. Weeds that exist in and around the field can also harbor disease pathogens and pest insects that can invade the carrot crop after planting. Many annual weeds produce copious amounts of seeds that often remain viable in the soils for many years. Early in the growing season, cultivation may control weed seedlings. As the growing season progresses, however, cultivation may damage the carrot roots. Application of herbicides may the only effective control method. Weeds can be divided into either annual broadleaf weeds or annual grass weeds (5).

Broadleaf Weeds:
Many broadleaf weeds adversely affect carrots in Minnesota. Some examples of annual broadleaf weeds are: velvetleaf (*Abutilon theophrasti*), common lambsquarters (*Chenopodium album),* pigweed (*Amaranthus retroflexus*), and giant and common ragweed (*Ambrosia trifida* and *Ambrosia artemisiifolia, respectively*). All of these weeds grow taller than carrots and can out-compete carrots for available light and soil nutrients. In absence of control, weeds will significantly reduce yields.

Grasses:
Annual grasses cause significant problems with carrot production because of their fast growth and ability to compete for resources. Additionally, they are tolerant to extreme moisture and temperature variation once established. They can be very difficult to eliminate from production areas and given their reproductive potential, they require management/control prior to seed-set. Examples are: foxtail (*Setaria spp.*), wild proso millet (*Panicum miliaceum*), and crabgrass (*Digitaria spp*).

Preemergence Herbicides:

- Trifluralin (Treflan HFP, Trilin, Trifluralin) is a pre-emergent herbicide labeled for use in mineral soils only at a rate of 1-2 pts/A. Use lower rates on sandy soils. Trifluralin is incorporated into the top 2-3 inches soon after spraying. Trifluralin provides good control of the annual grass weeds, lambsquarters, and pigweed. Trifluralin provides poor control of ragweed, smartweed, and velvetleaf. There is a 12 REI.
- Linuron (Lorox 50DF). provides fair control of annual grasses and good control of the many annual broadleaf weeds. Lorax is applied at a rate 1-2 lbs/A. There is a 14 day PHI and a 24 hour REI
- Paraquat (Gramoxone Extra 2.5E), RUP, is a postemergent broadleaf and grass herbicide. Paraquat is applied at a rate of 1.5-3 pts/A plus 1 qt COC or 4-8 oz nonionic surfactant/25 gallons water either before or after planting but before crop emerges. There is a 0 day PHI and a 12-24 hour REI

Postemergence Herbicides:

- Metribuzin (Sencor 4F or 75 DF) provides fair control of annual grasses and good control of the many annual broadleaf weeds. Sencor 4F and 75DF are applied at a rate 0.5 pt/A and 0.33 lb/A, respectively. There is 60 day PHI and a 12 hour REI
- Linuron (Lorox 50DF). provides fair control of annual grasses and good control of the many annual broadleaf weeds. Lorax is applied at a rate 1.5-3 lbs/A. There is a 14 day PHI and a 24 hour REI
- Fluazifop-butyl (Fusilade DX) provides good control of annual grasses. Fusilade DX 2E is applied at a rate 10-12 fl. oz/A plus 1 pt nonionic surfactant. There is a 45 day PHI and a 12 hour REI

Table 3. Weed control options: chemicals

Preemergence herbicides

Product	Field Rate	A.I. Rate	PHI/REI	Remarks*
Treflan HFP, Trifluralin, Trilin	1-2 pts/A	0.5-1 lb/A	-- 12 h	G. & BL. Pre-plant incorporate
Gramoxone Extra	1.5-3 pts/A	0.47-0.94 lb/A	-- 12-24 h	G & BL. Apply before or after planting but before crop emerges.
Lorox 50DF	1-2 lbs/A	0.5-1 lb/A	-- 24 h	G. & BL. Apply after seeding but prior to emergence; total must not exceed 4 lbs/A/yr.

* G: grass, BL: broadleaf

Postemergence herbicides

Product	Field Rate	A.I. Rate	PHI/REI	Remarks*
Sencor 4F, Sencor 75DF	4F: 0.5 pt/A 75DF: 0.33 lb./A	4F: 0.25-0.5 lb/A 75DF: 0.25 lb/A	60 d 12 h	G & BL. Broadcast when carrots have 5-6 leaves. Do not apply within 3 days of cool cloud weather or other pesticides application, or when temperature is >85 F; no tank mix
Lorox 50DF	1.5-3 lbs/A	0.75-1.5 lbs/A	14 d 24 h	G. & BL. Apply when crop is >3" tall; Do not apply if temps. >85° F; Total ≤4 lbs/A/ yr.
Fusilade DX	10-12 oz/A +1 pt nonionic surfactant	0.16-0.19 lb/A	45 d 12 h	G. Apply to actively growing grasses. Best control if applied at <30 gal water/A; total <48 oz/A/Yr

* G: grass, BL: broadleaf

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Acknowledgements

The Minnesota carrot crop profile was compiled and edited by Kathleen Bennett, Patrick O'Rourke and W. D. Hutchison, Minnesota Pesticide Survey and Impact Group, Department of Entomology, University of Minnesota.

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