Crop Profile: Carrots in New York

Introduction: NY produces just over 2000 acres of carrots annually, mostly for processing. Aster leafhoppers, Alternaria and Cercospora leaf blights, damping-off and seed decay, Rhizoctonia crown rot and foliar blight, root-knot nematodes, and a broad spectrum of annual and perennial weeds are the major pests requiring control. There are also a number of more sporadic but still economically significant pests. Without the registration of new, effective materials to replace them, the loss of chlorothalonil, thiram, oxamyl, iprodione, or linuron would have significant impacts on production and profitability.

Registration of new materials by the EPA, even those designated as "low risk", does not guarantee that NY growers will have immediate access to them. The New York State Department of Environmental Conservation conducts its own in-depth reviews before registering new pesticides for use in NY, and may or may not register new materials for portions of or for the entire state.

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II. Basic Commodity Information

State Rank: 6th in processing; 8th in fresh market
% U.S. Production: 1.54%
Acres Planted: 2150
Acres Harvested: 2100
Cash Value: $4,251,000
Yearly Production Costs: Not Available
Commodity Destination(s):
Fresh Market: 24%
Processing: 76%

Production Regions: Processing carrots are grown primarily in the Finger Lakes (Wayne, Ontario, Yates counties) and Lake Plains regions (Genesee, Orleans counties). Fresh market production is scattered throughout most of the agricultural regions of the state.

Cultural Practices: Light-textured soils that contain few stones or well-drained muck (high organic matter) soils are preferred. Primary tillage should be fairly deep, but care must be taken not to impair soil structure by working the soil when wet. Use of raised beds, which tend to increase drainage, aeration, and the total depth of tilled soil can improve the length and shape of roots. Seed 2 to 3 pounds per acre (1 to 2 pounds per acre for Chantenay and Danvers). Row spacing varies from 18 to 36 inches. Seed should be planted very close to the surface. A solid set irrigation system that can be used periodically during germination is ideal. Barley is planted along with carrots grown on muck soils for early-season erosion protection. The barley is later killed using selective herbicides. If soil moisture is limited, irrigating once or more during root enlargement will prove beneficial. Machine harvesters are used for the processing crop and for roots that are marketed in polyethylene bags. Carrots for bunching are hand harvested and tied together.

III. Pest Information: Insects

1. Aphids (various spp.)

Frequency of Occurrence: Sporadic pest that can become serious.
Damage Caused: Aphids (primarily *Myzus persicae*) attack both the roots and foliage of plants. Tops may be weakened and break during harvest, leaving carrot in the ground.
% Acres Affected: 100% at risk; usually 1-5% affected per year.

Pest Life Cycles: Most species of aphid overwinter in the egg stage. The eggs hatch in the spring to produce a generation of females. These female aphids give birth to live young. Generally the first young aphids are wingless however, when a colony becomes too crowded, winged forms may be produced. The winged forms migrate to new host plants and begin new colonies. Enormous populations can be built up from these overlapping generations all summer long. Late in the season the aphids migrate back to the original host plant and a generation consisting of both males and females is produced. These individuals mate and the females lay eggs which will overwinter.

Timing of Control: Treatment threshold is 25% of plants affected.

Yield Losses: If infested fields untreated, as high as 10%.

Cultural Control Practices: Sanitation, crop rotation with non-host crops, and site selection are not currently viable management options. Aphid populations decline rapidly during periods of heavy rainfall. No resistant varieties are available.

Regional Differences: None.

Biological Control Practices: Conserving natural enemies can be helpful in controlling aphid populations.

Post-Harvest Control Practices: None.

Other Issues: Aphids are not typically an economically important pest, but some effective control measure is necessary in those instances where they do exceed the established threshold. Insecticides used to control aster leafhoppers may keep aphid populations below threshold.

Chemical Controls:

diazinon						
% Trt.	**Type of Appl.**	**Typical Rates**	**Timing**	**# of Appl.**	**PHI**	**REI**
<1	foliar, ground	0.5 lbs. AI/Acre	On as needed basis. Threshold is 25% of plants infested.	1	14 days	24 hours

endosulfan						
% Trt.	**Type of Appl.**	**Typical Rates**	**Timing**	**# of Appl.**	**PHI**	**REI**
5	foliar, ground	0.75 lbs. AI/Acre	On as needed basis. Threshold is 25% of plants infested.	1	21 days	24 hours

Use in IPM Programs: Use of either endosulfan or diazinon on an as needed basis is consistent with Cornell IPM recommendations for carrots.

Use in Resistance Management: No resistance to either material has been reported.

Alternatives: Esfenvalerate may provide control, but research would need to be conducted to determine efficacy.

2. Aster Leafhopper (*Macrosteles quadrilineatus*)

Frequency of Occurrence: Annually.

Damage Caused: This insect transmits the disease aster yellows, caused by the aster yellows phytoplasma. The severity of aster yellows depends on the population of leafhoppers and their % infection with the pathogen. This is usually correlated with the level of crop infection the previous year. Symptoms include leaf yellowing and reddening, distorted growth, brittle petioles (causing difficulties in harvesting and bunching), and stunted and misshapen roots "hairy root condition". Affected plants are unusable.

% Acres Affected: 100%

Pest Life Cycles: Aster leafhoppers overwinter on perennial weeds or fall-planted small grains as both eggs and adults. In spring adults migrate to other herbaceous host plants. The incubation period for aster yellows is 10 to 18 days. Aster yellows is usually transmitted by adult leafhoppers because nymphs molt and rapidly mature into adults in about 18 days.

Timing of Control: At first appearance of pest, continued up until one month before harvest.
Yield Losses: If untreated, losses could amount to 50%. If treated, losses still amount to 1 to 5%.
Cultural Control Practices: Cultural controls can augment insecticides, but cannot provide adequate control if used alone. These include controlling weeds that harbor aster yellows, avoiding planting near lettuce and grains, destroying crop debris after harvest, and crop rotation. No resistant varieties are available.
Regional Differences: None.
Biological Control Practices: None.
Post-Harvest Control Practices: None.

Chemical Controls:

carbaryl						
% Trt.	**Type of Appl.**	**Typical Rates**	**Timing**	**# of Appl.**	**PHI**	**REI**
15	foliar, ground	1.2 lbs ai/acre	from first appearance of leafhoppers up to one month before harvest	2	60 days	24 hours

cyfluthrin						
% Trt.	**Type of Appl.**	**Typical Rates**	**Timing**	**# of Appl.**	**PHI**	**REI**
10	foliar, ground	0.03 lbs ai/acre	from first appearance of leafhoppers up to one month before harvest	1	60 days	1 hours

esfenvalerate						
% Trt.	**Type of Appl.**	**Typical Rates**	**Timing**	**# of Appl.**	**PHI**	**REI**
90	foliar, ground	0.034 lbs ai/acre	from first appearance of leafhoppers up to one month before harvest	5	30 days	24 hours

Use in IPM Programs: Use of all three materials on an as needed basis is consistent with Cornell IPM recommendations for carrots.
Use in Resistance Management: Alternating between two or three insecticides in different chemical classes is important for resistance management.
Alternatives: While current pyrethroids provide good control, it is prudent to have a non-pyrethroid labeled as well for resistance management. Research is needed on efficacy of new non-pyrethroid insecticides in carrots.
Other: Research is currently being conducted to refine the use of disease forecasting for scheduling fungicide applications for foliar diseases (Abawi).

3. Carrot Weevil (*Listronotus oregonensis*)

Frequency of Occurrence: Carrot weevil is a very sporadic pest of carrots in NY. Insecticides used to control aster leafhoppers may also be controlling carrot weevils.
Damage Caused: Larvae feed on roots, eventually leading to the death of the plant.
% Acres Affected: 100% at risk; typically <1% affected.
Pest Life Cycles: Eggs are laid in leaf axils at crown in spring, larvae tunnel in carrot root.
Timing of Control: As needed.
Yield Losses: <5%
Cultural Control Practices: None.
Regional Differences: None.
Biological Control Practices: None.

Post-Harvest Control Practices: None.

Chemical Controls: Use of esfenvalerate for Aster leafhopper control may keep this pest under economically damaging levels.

4. Spider mites (*several species*)

Frequency of Occurrence: Spider mites are a very sporadic pest of carrots in NY, but can cause economic damage in hot, dry weather.

Damage Caused: Mites feed on plant juices, causing stunting, deformed leaf growth, reduced yields, and increased harvest loss due to weak tops.

% Acres Affected: 1%

Timing of Control: As needed.

Yield Losses: <5%

Cultural Control Practices: None.

Regional Differences: None.

Biological Control Practices: None.

Post-Harvest Control Practices: None.

Chemical Controls: No effective insectides are labeled for mite control in carrots in New York.

Alternatives: Abamectin might be an effective control, but trials would need to be conducted.

IV. Pest Information: Diseases and Nematodes

1. Alternaria Leaf Blight (*Alternaria dauci*)

Type of Pest: Fungus

Frequency of Occurrence: Annually.

Damage Caused: Alternaria leaf blight symptoms begin as dark brown to black irregularly shaped lesions on leaf blades and petioles. Spots are initially surrounded by a yellow margin and often begin on the older leaves. Leaves can be killed when spots grow together. Lesions that develop on petioles may kill entire leaves. Leaves weakened by blight may break off when gripped by a mechanical harvester, resulting in the roots being left in the ground. The pathogen also causes damping off of carrot seedlings.

% Acres Affected: 100%

Pest Life Cycles: The disease is favored by rainy weather and/or overhead irrigation. The pathogen survives in carrot debris and volunteer carrots. It can also be seedborne. Spores are dispersed in air and splashing water. The optimum temperature for growth and infection is 82°F with some infection occurring at temperatures as low as 57°F and as high as 95°F. Although the fungus survives on carrot debris left in the field after harvest, once the crop residue decomposes, the fungus dies.

Timing of Control: Use a research-based threshold and disease-forecasting model to time control measures for Alternaria leaf blight.

Yield Losses: Up to 100%.

Cultural Control Practices: Use Alternaria indexed seed. Turn under carrot residue to encourage decomposition of debris. Crop rotation is very important. Do not plant new fields near infested fields. Recent research is indicating significant differences in varietal response to Alternaria. Carrots grown in well-fertilized soil may have more tolerance to the disease. Soaking seeds in hot water (122^{o} F) for 25 minutes, but no longer, may help control seed-borne Alternaria.

Regional Differences: None.

Biological Control Practices: None.

Post-Harvest Control Practices: Turn under carrot residue to encourage decomposition of debris.

Chemical Controls:

chlorothalonil						
% Trt.	**Type of Appl.**	**Typical Rates**	**Timing**	**# of Appl.**	**PHI**	**REI**
100	foliar, ground	1.5 lbs. AI/Acre; but actual rates vary considerably	as needed during the season	4*	7 days	48 hours

*ranges from 2-8, depending on weather conditions

iprodione						
% Trt.	**Type of Appl.**	**Typical Rates**	**Timing**	**# of Appl.**	**PHI**	**REI**
2	foliar, ground	0.5 lb AI/Acre	as needed during the season	1	7 days	12 hours

Use in IPM Programs: Use of these materials on an as needed basis is consistent with Cornell IPM recommendations. Recent research is refining a weather-based scouting and forecasting approach to timing applications. Need for applications depends heavily on rainfall and temperature.

Use in Resistance Management: No instances of resistance have been reported.

Alternatives: Research indicates that there are varietal differences in tolerance to the disease, but true resistant varieties are not yet available. Mefanoxam is labeled for use, but is most effective when combined with chlorothalonil. Research on the efficacy of azoxystrobin, trifloxystrobin and tebuconazole, possible alternatives, should be conducted. IR-4 is scheduled to conduct residue tests on tebuconazole in carrots.

2. Cercospora Leaf Blight (*Cercospora carotae*)

Type of Pest: Fungus

Frequency of Occurrence: Occurs about once every two years.

Damage Caused: Cercospora leaf blight can occur on any aboveground carrot tissue. However, its symptoms are usually most severe and obvious along leaflet margins. Infection sites initially appear as a brown spot with a dark brown margin. A chlorotic halo often develops around these spots. As the disease progresses, the leaflets become yellowed and curled at the margins. Lesions on leaf petioles, stems, and flower parts are usually elongated and dark brown. Under heavy disease pressure severe loss of foliage may occur.

% Acres Affected: 100% at risk; typically up to 25% affected, depending on weather conditions.

Pest Life Cycles: The pathogen can be seedborne, but also survives between crops on plant debris or in the soil. Infection occurs over a wide range of temperatures with an optimum at 82o F.

Timing of Control: Because the disease develops quickly in hot or humid weather, it is likely to occur in July or early August.

Yield Losses: Up to 50% in untreated affected areas.

Cultural Control Practices: Destruction of crop refuse. Crop rotation. Resistant varieties are not available.

Regional Differences: None.

Biological Control Practices: None.

Post-Harvest Control Practices: Destruction of crop refuse.

Chemical Controls: Chlorothalonil applications used to control Alternaria leaf blight also provide control of Cercospora (see previous section for typical use pattern).

Alternatives: Research needs to be conducted to test the efficacy of the following possible alternatives: azoxystrobin, myclobutanil, tebuconazole, and trifloxystrobin.

3. Damping Off and Seed Decay (*Pythium* and *Rhizoctonia* spp.)

Type of Pest: Fungus
Frequency of Occurrence: Affects most carrot acreage annually, depending on weather.
Damage Caused: Damping off and seed decay can cause decay and death of seeds or small seedlings prior to or soon after emergence.
% Acres Affected: 100%
Pest Life Cycles: Pythium and Rhizoctonia are soil-borne fungi with wide host ranges.
Timing of Control: At planting.
Yield Losses: Up to 20% in affected, untreated areas.
Regional Differences: None.
Cultural Control Practices: Planting on well-drained soil with good structure can aid in disease control. Rotation with non-hosts such as grain crops can also aid control. Resistant varieties are not available.
Regional Differences: None.
Biological Control Practices: None.
Post-Harvest Control Practices: None

Chemical Controls:

thiram						
% Trt.	**Type of Appl.**	**Typical Rates**	**Timing**	**# of Appl.**	**PHI**	**REI**
100	seed treatment	4 oz ai/100 lbs of seed (=.006 lbs ai/acre)	Pre-plant	1	120 days	

Use in IPM Programs: Use of both materials is consistent with Cornell IPM recommendations.
Use in Resistance Management: No instances of resistance have been reported.
Alternatives: Mefanoxam is labeled for this use, but is only effective on Pythium, not on Rhizoctonia. Seed treatment using Maxim (fludioxonilz) is a potential alternative for Rhizoctonia control. Research needs to be conducted to test the efficacy of the following possible alternatives: azoxystrobin, myclobutanil, tebuconazole, and trifloxystrobin.

4. Rhizoctonia Crown Rot and Foliar Blight (*Rhizoctonia solani*, and its sexual state, *Thanatephorus cucumeris*)

Type of Pest: Fungus
Frequency of Occurrence: A sporadic pest in the past, but incidence and severity have increased notably in recent years.
Damage Caused: This pathogen causes both crown rot and foliar blight diseases in carrots. Crown rot symptoms result from infections on the main root, causing brown to black sunken cankers that may penetrate several millimeters into the taproot. Infected roots are unsalable. Foliar blight symptoms first appear on petioles or in the crown areas. Cankers appear on infected areas, and severely infected plants may die.
% Acres Affected: 100% at risk; up to 50% affected per year.
Pest Life Cycles: Rhizoctonia is a soil-borne disease with a wide host range. The fungus survives both in the soil and on infected plant debris. The sexual stage has recently been observed on carrots and other vegetables in NY, and this may be the reason for the increasing problem with this pathogen.
Timing of Control: Season-long.
Yield Losses: Up to 20% in infected areas.
Cultural Control Practices: No resistant varieties are available. Useful practices include rotation with non-hosts such as grain crops, modifying microclimate by decreasing plant populations (although this decreases yield), avoiding excessive hilling operations, and planting vigorous, disease-free seed that has been treated with a fungicide.
Regional Differences: None.

Biological Control Practices: None.
Post-Harvest Control Practices: Plow crop debris immediately after harvest to remove this source of disease.

Chemical Controls:

iprodione						
% Trt.	**Type of Appl.**	**Typical Rates**	**Timing**	**# of Appl.**	**PHI**	**REI**
2	foliar, ground	0.5 lbs ai/acre	as needed	1	7 days	12 hours

Use in IPM Programs: Use is consistent with Cornell IPM recommendations, which call for protective treatments in fields with a history of this disease.
Use in Resistance Management: No instances of resistance have been reported.
Efficacy Issues: Iprodione applications are only effective against crown rot if applied before the occurrence of infection (prior to hilling) and with thorough coverage of petioles and crown area. This may explain why the use of this material is low, even though the problem is widespread. A new, effective foliar-applied fungicide is much needed. Iprodione applications are effective against the foliar blight.
Alternatives: Research needs to be conducted to test the efficacy of the following possible alternatives: azoxystrobin, myclobutanil, tebuconazole, and trifloxystrobin.

5. Sclerotinia White Mold (*Sclerotinia sclerotiorum*)

Type of Pest: Fungus
Frequency of Occurrence: Sporadic.
Damage Caused: White mold attacks all parts of the plant, rendering the root unusable. Root decay may occur before wilting is seen on aboveground plant parts. A cottony, white mycelium appears on the affected area.
% Acres Affected: 100% at risk; typically up to 25% affected.
Pest Life Cycles: The fungus overwinters in the soil as a small hard structure called sclerotia. In the spring the presence of moisture causes the sclerotia to germinate and produce apothecia which then produce spores. The spores are distributed by rain splash, insects, and other mechanical means to the carrots. When the fungus has exhausted all the nutrients of the host plant, it begins to form sclerotia. This fungus has a very wide host range.
Timing of Control: When disease first appears.
Yield Losses: In affected, untreated fields, losses can be as high as 20%.
Cultural Control Practices: Resistant varieties are not available. Deep plowing once per year to bury sclerotia eight to ten inches deep may reduce disease incidence. Some control may be gained by selecting sites with good air and water drainage, and avoiding fields with known white mold problems.
Regional Differences: None.
Biological Control Practices: None.
Post-Harvest Control Practices: None.

Chemical Controls:

benomyl						
% Trt.	**Type of Appl.**	**Typical Rates**	**Timing**	**# of Appl.**	**PHI**	**REI**
2	foliar, ground	0.125-0.5 lbs. AI/Acre	At any growth stage, at appearance of disease.	1	7 days	24 hours

Use in IPM Programs: Consistent with Cornell IPM recommendations.
Use in Resistance Management: No instances of resistance have been reported.
Alternatives: None of the new fungicide materials is effective against Sclerotinia.

6. Bacterial Leaf Blight (*Xanthomonas campestris* pv. *carotae*)

Type of Pest: Bacterial
Frequency of Occurrence: Sporadic.
Damage Caused: Bacterial leaf blight causes small yellow lesions on the leaflets. The centers of the lesions become dry and brown and are often surrounded by a yellow halo. Affected plants are stunted, and leaves weakened by blight may break off when gripped by a mechanical harvester, resulting in the roots being left in the ground.
% Acres Affected: 15%
Pest Life Cycles: Xanthomonas is seedborne and survives on and is spread with carrot seed. The bacteria also survive in carrot debris but cannot survive in the soil in the absence of debris. Rain or sprinkler irrigation is required for optimum disease development. Warm weather favors infection and disease development. Optimum temperatures are between 77o F and 86o F; infection does not occur below 65o F. The pathogen is dispersed in splashing water.
Timing of Control: When pest first appears.
Yield Losses: Up to 50% on affected, untreated areas.
Cultural Control Practices: Crop rotation and good sanitation practices may help control this disease.
Regional Differences: None
Biological Control Practices: None.
Post-Harvest Control Practices: None.

Chemical Controls:

fixed copper compounds						
% Trt.	**Type of Appl.**	**Typical Rates**	**Timing**	**# of Appl.**	**PHI**	**REI**
3	foliar, ground	0.6 lbs ai/acre, depending on formulation used	As needed, when disease becomes apparent.	1	14 days	48 hours

Use in IPM Programs: Use is consistent with Cornell IPM recommendations.
Use in Resistance Management: No instances of resistance have been reported.
Efficacy Issues: Copper sprays may slow the spread of infection, but will not provide complete control.

7. Root-knot Nematode (*Meloidogyne hapla*)

Type of Pest: Nematode
Frequency of Occurrence: Annually on affected acres.
Damage Caused: Nematodes cause galling, forking and discoloration of roots. Damaged roots are unmarketable.
% Acres Affected: 100% at risk; up to 75% affected.
Pest Life Cycles: Root-knot nematodes spend most of their life cycle in galls on roots. Second stage juveniles invade new sites near root tips and the carrot forms a gall in response to the nematode's feeding. Many vegetable and weed species also serve as hosts for this nematode. The damage threshold is less than one egg per cc of soil, but soil testing is not a practical method for determining occurrence and severity of this nematode.
Timing of Control: Controls must be applied at or before planting.
Yield Losses: Can be up to 100% if untreated; 5-10% if treated.
Cultural Control Practices: Rotation with grain crops is very important for control of this pest.
Regional Differences: None.
Biological Control Practices: None.
Post-Harvest Control Practices: None.

Chemical Controls:

oxamyl						
% Trt.	**Type of Appl.**	**Typical Rates**	**Timing**	**# of Appl.**	**PHI**	**REI**
20	Preplant, in-furrow drench	3 lbs ai/acre	preplant	1	120 days	48 hours

Use in IPM Programs: Use is consistent with Cornell IPM recommendations.
Use in Resistance Management: No instances of resistance have been reported.
Alternatives: The use of sudangrass cover crops may suppress nematode populations.
Other Issues: A growing-out bioassay for the root-knot nemetode is available, but it is costly in time and money. Research is in progress to develop a rapid and accurate molecular diagnostic method for the detection and quantification of this nematode in NY. Research results have demonstrated that the application of oxamyl as a broadcast treatment to control this nematode on carrot is more effective than the in-furrow drench applications at the same rates. More research is needed on efficacy of lower rates as broadcast applications. Research is also being conducted on the efficacy of sudangrass cover crops for nematode control (Abawi).

V. Pest Information: Weeds

1. Broadleaf and Grass Weeds

Frequency of Occurrence: Annually.
Damage Caused: Reduced yields from weed competition, and loss due to interference with harvesting equipment.
% Acres Affected: 100%
Pest Life Cycles: Annual and perennial weeds such as ragweed, lambsquarters, henbit, Galinsoga, mare's tail, yellow nutsedge, annual and perennial grasses, mustards, and others, are a problem throughout the growing season. In addition, barley windbreaks are needed to avoid the potential of total early season crop loss on muck soils. The barley must then be killed to avoid competition with the crop.
Timing of Control: Preplant, preemergence, and postemergence.
Yield Losses: Can be 100% if not treated, 5% if treated.
Regional Differences: None.
Cultural Control Practices: Cultivation is effective in conjunction with herbicide applications. Most carrot growers cultivate at least once per season. Cultivation does not control in-row weeds, and aggressive cultivation can damage roots and exacerbate disease problems. Cultivation on muck soils is limited by the use of barley windbreaks. Cover crops and crop rotation may be useful in managing weed populations, but these effects are not well understood. Weed maps can be used as a monitoring measure in an IPM program. Banding herbicides is not useful in carrot production due to the small number of registered products and their narrow weed control spectra.
Regional Differences: None.
Biological Control Practices: None.
Post-Harvest Control Practices: Cultivation. Post-harvest application of herbicides to control perennial weeds.

Chemical Controls:

linuron						
% Trt.	**Type of Appl.**	**Typical Rates**	**Timing**	**# of Appl.**	**PHI**	**REI**
100	foliar, ground	0.25-.50 lbs. AI/Acre; varies considerably. Seasonal limit of 4 lbs ai/acre.	Postemergence. Early in season, between 1 and 5 leaf stages.	2; varies considerably	100 days	24 hours

Efficacy Issues: Effective on many broadleaf weeds including ragweed, henbit, and Galinsoga, and many annual grasses. Nutsedge may be suppressed. Weather conditions and interactions with tank-mixed materials can constrain the timing of application of linuron. Multiple applications of low rates (0.125 to 0.25 lbs ai/acre) provide best weed control and least crop injury.

metribuzin						
% Trt.	**Type of Appl.**	**Typical Rates**	**Timing**	**# of Appl.**	**PHI**	**REI**
35	foliar, ground	0.25 lbs. AI/Acre	Postemergence. Apply after carrots have formed 5-6 true leaves but before weeds are 1 inch in height.	1	60 days	12 hours

Efficacy Issues: Effectively controls many broadleaf weeds including redroot pigweed, common lambsquarters, galinsoga, and some annual grasses. Suppression of nutsedge and common ragweed has been observed. Weather conditions and interactions with tank-mixed materials can constrain the timing of application of metribuzin. Multiple applications of low rates (0.125 to 0.25 lbs ai/acre) provide best weed control and least crop injury. On high organic matter soils there is risk for carryover the following season, and there are rotational restrictions.

trifluralin						
% Trt.	**Type of Appl.**	**Typical Rates**	**Timing**	**# of Appl.**	**PHI**	**REI**
20	foliar, ground	0.5 lbs. AI/Acre	Preplant incorporated	1	120 days	12 hours

Efficacy Issues: Effective on grasses and some broadleaf weeds except ragweed, mustard, and Galinsoga spp. Ineffective on muck soils.

fluazifop-p-butyl						
% Trt.	**Type of Appl.**	**Typical Rates**	**Timing**	**# of Appl.**	**PHI**	**REI**
50	foliar, ground	0.19 lbs. AI/Acre	Postemergence;	1.5	30 days	12 hours

Efficacy Issues: Effective on annual grasses and barley windbreaks. Apply when grasses are actively growing.

sethoxydim						
% Trt.	**Type of Appl.**	**Typical Rates**	**Timing**	**# of Appl.**	**PHI**	**REI**
1	foliar, ground	0.09-0.28 lbs. AI/Acre	Postemergence	1	30 days	12 hours

Efficacy Issues: Effective on annual grasses and barley windbreaks. Apply when grasses are actively growing and not under stress.

Use in IPM Programs: Use of each of the materials listed is consistent with IPM recommendations.
Alternatives: IR-4 is scheduled to run residues on ethofumasate in carrots. Research is needed to determine efficacy under NY conditions.

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6. Information for and review of this Crop Profile were provided by members of the New York State Carrot Roundtable, an advisory committee comprised of producers, processors, consultants, researchers and Extension Educators.