# Draft: Processing Carrot Pest Management Strategic Plan for New Jersey

March 16, 2004

Rutgers Agricultural Research and Extension Center
121 Northville Rd
Bridgeton, NJ

**Work Group Participants**

Robin Brumfield; Specialist in Farm Management; Rutgers Cooperative Extension; Agricultural, Food, and Resource Economics; Cook Office Building, Room 111; 55 Dudley Road; New Brunswick, NJ 08901; (732) 932-9171 x253; brumfield@aesop.rutgers.edu.

Edward Brynes; NJ Grower; Brynes Farm; 230 A Sharptown-Auburn Road; Pilesgrove, NJ 08908; 856-769-2002 (f); 856-491-0320 ©; usafarmers@lycos.com.

David Drake; Specialist in Wildlife; Rutgers Cooperative Extension; 80 Nichol Avenue; New Brunswick, NJ 08901; (732) 932-8993; drake@rce.rutgers.edu.

Meredyth Fogg; Graduate Assistant in Vegetable Pathology; Rutgers Agricultural Research and Extension Center; 121 Northville Road; Bridgeton, NJ 08302-5919; (856) 455-3100; mfogg@rci.rutgers.edu.

Gerald Ghidiu; Specialist in Entomology; Rutgers Agricultural Research and Extension Center; 121 Northville Road; Bridgeton, NJ 08302-5919; (856) 455-3100; ghidiu@aesop.rutgers.edu.

George Hamilton; Specialist in Pest Management; RCE Pest Management Office; 93 Lipman Drive; New Brunswick, NJ 08901-8524; (732) 932-9801; hamilton@aesop.rutgers.edu.

Patricia Hastings; Program Associate- Pest Management; RCE Pest Management Office; 93 Lipman Drive; New Brunswick, NJ 08901-8524; (732) 932-4271; hastings@aesop.rutgers.edu.

Grant Hitchner; NJ Grower; 380 Jefferson Rd; Elmer, NJ 08318; 856-358-2579; kj_hitchner@yahoo.com.

Erin Hitchner; IR-4 Field Researcher; Rutgers Agricultural Research and Extension Center; 121 Northville Road; Bridgeton, NJ 08302-5919; (856) 455-3100; hitchner@aesop.rutgers.edu.

William Hogeland; PA grower; Hogeland Farms; 202 Kalbach Road; Newmanstown, PA 17073; 717-949-2107; fax: 717-949-9817.

Kristian Holmstrom; Program Associate- Vegetable IPM; RCE Pest Management Office; 93 Lipman Drive; New Brunswick, NJ 08901-8524; (732) 932-9801; holmstrom@aesop.rutgers.edu.

Joseph Ingerson-Mahar; Vegetable IPM Coordinator; RCE Pest Management Office; 93 Lipman Drive; New Brunswick, NJ 08901-8524; (732) 932-9801; mahar@aesop.rutgers.edu.

Edith Lurvey; IR-4 Region Field Research Coordinator, IR-4 Program; Cornell University Dept. of Food Science & Technology; NYS Agricultural Experiment Station; 630 W. North Street; Geneva, NY 14456-0462; 315-787-2308; ell10@cornell.edu.

Bradley Majek; Specialist in Weed Science; Rutgers Agricultural Research and Extension Center; 121 Northville Road; Bridgeton, NJ 08302-5919; (856) 455-3100; majek@aesop.rutgers.edu.

Tom Mangas; Campbell Soup; Camden, NJ 08103-1701; 856-342-6197; tom_mangus@campbellsoup.com.

Luke McConnell; President and Owner; McConnell Agronomics, Inc.; 7735 Dyer Road; Denton, MD 21269; 410-479-3664; cell: 302-228-4025.; mccagro@shore.intercom.net.

Bob Mulrooney; Extension Plant Pathologist; Dept. of Plant and Soil Sciences; 151 Townsend Hall; Newark, DE 19716-2170; 302-831-4865; bobmul@udel.edu.

E. Larry Rossell; IR-4 Field Researcher; Rutgers Agricultural Research and Extension Center; 121 Northville Road; Bridgeton, NJ 08302-5919; (856) 455-3100; rosell@aesop.rutgers.edu.

Kenneth Samoil; Technical Coordinator; Entomology Working Group; IR-4 Project; The Technology Centre of New Jersey; 681 Highway #1, South; North Brunswick, NJ 08902-3390; (732)932-9575 ext 614; samoil@aesop.rutgers.edu.

James Van Kirk; Coordinator, Northeastern Integrated Pest Management Center; NYSAES; 630 W.North Street; Geneva, NY 14456; (315) 787-2378; jrv1@cornell.edu.

Melissa Zimmerman; Rutgers Agricultural Research and Extension Center; 121 Northville Road; Bridgeton, NJ 08302-5919; (856) 455-3100; zimmerman@aesop.rutgers.edu.

# Table of Contents



==========

# Executive Summary

Top Priorities of New Jersey Carrot Production

Regulatory

Research

Education

==========

# Background

## Production Facts

- State rank: New Jersey ranks 9th nationally in carrot production, 1997 data
- Typical per acre yields: 20 to 27 tons
- Annual production costs: $800 to $1200/acre
- Percent of crop for processing and fresh market: 93% processing; 7% fresh market

## Production Regions

*Southern New Jersey (area south of Trenton)*

All processing carrots, *Daucus carota sativa*, are grown in the southern half of New Jersey with most of the fresh market acreage grown in central and northern New Jersey. The soils in the south are coastal plain, generally light soils ranging from sand to sandy loams, but areas of heavier, clay and silt loam soil do exist. Elevations are low with most of the area less than 200 feet in elevation. The warmest, seasonal temperatures occur in the extreme southern part of the state with the Salem County area being the warmest.

## Cultural Practices

Carrots are raised in both sandy loam and silt loam soils. Fields are fumigated principally with Vapam prior to planting for nematode, disease pathogen and some weed control. Depending upon soil test results for nematodes Telone II may also be used.

Processing carrots are direct seeded in the field in single rows with 22 inches between rows. All processing carrots are "dicers" and are planted at a rate of 12 to 14 ounces per acre equivalent to approximately 300,000 seeds per acre. The desired seeding rate per foot is from 12 to 15 with a final stand count of 7 to 8 carrots per foot. There is only one planting a year. Planting occurs from mid-April to early May. Harvest begins in October and in most years is completed by mid-November. Weather conditions may interfere with harvesting so that harvesting continues until completion or until the ground freezes.

Because Campbell Soup Company is the primary carrot processor for New Jersey farmers, Campbell Soup variety 1374 is the primary variety grown. At the first cultivation the soil is mounded up onto the carrots to help prevent greening of the shoulders. After successive cultivations the carrot rows have taken the form of raised beds. Two farmers plant onto 9" tall ridges made prior to seeding; one farmer uses a one-row ridge and the other uses a 3 row bed.

*The manner in which carrots are harvested in New Jersey differs significantly from Michigan's harvesting techniques. Michigan farmers rely on healthy top, "fern" growth in order to pull carrots from the soil. This places much greater emphasis on the role of fungicides in Michigan production as foliar diseases significantly reduce the vitality and strength of the fern growth.*

Harvesting New Jersey carrots is a two step process. First a machine that "tops" the carrot plant is brought through the field which slices off the top end of the carrots – three to six rows at a time depending whether the carrots were on ridges or not. After topping the harvester (a modified potato digger) digs under the carrots lifting them out onto a chain conveyor belt separating the carrots from the dirt. The carrots are loaded directly into a truck and taken to the packing house for further cleaning and sorting. They are then loaded into a second truck which proceeds to the processor.

==========

## Critical Pest Information

The primary pests of the carrot processing industry are carrot weevil, leaf blights, and northern root knot nematode. Several minor pests occur including wireworms, cutworms, aster leafhopper, bacterial blight, fungal rots, and vertebrate pests such as deer and woodchucks. In other carrot production areas such as Ontario, Canada, and Michigan, the same pests may be found but they impact the crops differently. Leaf blights are more important in those areas because of the difference in how the crop is harvested and carrot weevil is less important possibly because of greater flexibility of crop rotation and harsher winters in those areas.

==========

## Critical Pesticide Information

Seven pesticides currently registered for use on carrots may potentially be lost due to regulatory challenges. This would be particularly critical for carrot weevil and nematode control as alternate effective materials are lacking and for prevention of disease resistance since chlorothalonil is used alternating with strobilurin use on carrots.

==========

## IPM Issues

1) Management of carrot weevil
- At the moment the most effective control device appears to be a hard winter
- Monitoring carrot weevil during the season
- Eliminating alternate hosts
- Issue of either resistance or poor pesticide effectiveness
- Lack of registered effective insecticide

2) Potential disease resistance with strobilurin fungicides

3) Incorporation of other fungicide class use in Tomcast recommendations

4) Potential loss of current nematicides due to FQPA

5) Lack of implementation of biocontrol agents for any of the primary or secondary pests

==========

## Resistance Management Issues

Potential resistance development to strobilurin fungicides.

==========

## Consumer Education Issues – None?

==========

## Export/Import Issues – None?

==========

# Pest by Pest Profiles

==========

## Insect Pests

### *1) Carrot weevil*

*Listronotus oregonensis*. Carrot weevil is the most important insect pest of carrots in New Jersey and can be found in all or nearly all carrot fields. It is threatening the viability of the processing carrot industry in New Jersey.

Carrot weevils have historically been a significant pest of carrots in New Jersey as in other carrot production areas. Factors that may enhance carrot weevil problems in New Jersey may include: 1) lack of space for crop rotation, 2) mild winters, 3) lack of effective insecticides, 4) lack of viable alternative management options including management of alternate hosts for the weevil, 5) the use of culled carrots as deer bait.

Carrot weevils have three overlapping generations a year so that all life stages may be found at any time during the growing season. Adults and pupae and possibly larvae overwinter in the fields and other sheltered areas including fencerows and field borders. Several weeds serve as alternate hosts for weevils including broadleaf plantain, lance-leaf plantain, Queen Anne's lace and various species of dock. Carrots become attractive to the weevil at about the 4 true leaf stage. The females lay eggs in slits on the petioles of the leaves. Newly hatched larvae fall to the ground and begin feeding externally on the root. Carrots may still be marketable despite feeding injury as long as it is superficial; however, deep tunneling is unacceptable. After 4 molts pupation occurs either in the carrot or more commonly in a small cell formed in the soil up to an inch away from the carrot. Male and female weevils are extremely difficult to differentiate. Adults have wings but apparently fly very little, if at all, and most of their distribution comes from walking.

Currently bait traps are used to help determine the presence of active weevils. A fresh carrot is placed in a slot cut in a 2x4 inch piece of wood and placed on the ground along the borders of the field and is checked once or twice a week for adult weevils. Traps are subject to tampering by deer, groundhogs and mice which limits the effectiveness of the traps. These traps are generally effective until the carrots in the field become attractive to the weevils. Pitfall traps (plastic cups set in the ground flush with the soil surface containing an antifreeze mixture which both kills insects and preserves them) also trap weevils and these can be deployed in monitoring of carrot weevil.

<u>Insecticides for use on carrot weevil</u>

<u>Organophosphates</u>
None recommended

<u>Carbamates</u>
Oxamyl – Vydate L

- Efficacy
- Resistance problems - ?
- IPM Issues
- REI - 48
- PHI – 14 days

- Export/import issues - none
- Why used /not used?

Other - pyrethroids

Cyfluthrin – Baythroid 2

- Efficacy
- Resistance problems - ?
- IPM Issues
- REI - 12
- PHI – 0 days
- Export/import issues – none?
- Why used /not used?

Esfenvalerate – Asana XL

- Efficacy
- Resistance problems
- IPM Issues
- REI - 12
- PHI – 7 days
- Export/import issues – none?
- Why used /not used?

Pest Management Concerns

- Biological control of carrot weevils by Anaphes sordidanus (an egg parasitoid)
- Control of broad leaf weeds in field borders, especially wild carrot and pineapple weed, plantain and others
- Trapping to determine pest density and timing of insecticide applications
- Use of carrot culls as deer bait
- Trap cropping with overwintered parsley

Pipeline pest management tools

- Status of imidan?
- An ipm program has not been developed to address preferred selection of materials. Esfenvalerate may be a more environmentally benign material but it overall effectiveness in reducing carrot weevil populations is questionable.

To Do

*Regulatory*

*Research*

- Design pitfall traps for easier monitoring of carrot weevil in the field
- Design woodchuck resistant bait traps

*Education*

## *2) Wireworms*

Wireworms are a secondary pest. Currently there is no chemical recommendation for wireworms in carrots. Using bait traps and knowledge of field history, farmers should avoid fields with significant

wireworm infestations. Two of the carrot farms are in areas where wireworm infested fields are common. Wireworm feeding injury tends to be short holes more or less straight into the carrot, though occasionally tunneling occurs in the center of the carrot. The most likely crop damaging species is *Melanotus communis*. *Melanotus* wireworms may exist in the soil for 5 or 6 years although other species have one or three year life cycles. Bait traps can be used to estimate the severity of wireworm infestation before the crop is planted, either in the spring or previous fall.

Insecticides for wireworm control

Organophosphates

Carbamates

Other - pyrethroids

Pest Management Concerns

- Trapping to determine pest density
- Mapping fields of known infestations for avoidance

Pipeline pest management tools

To Do

*Regulatory*

*Research*

*Education*

## *3) Cutworms*

Black cutworm, particularly, is a secondary pest. There are multiple generations in New Jersey making it difficult to synchronize larval activity with pesticide applications. Resulting damage sporadically occurs late in summer or early fall resulting in large excavated cavities in the root. This is in contrast to Michigan information which suggests more early-season problems.

Insecticides for cutworm control

Organophosphates
None

Carbamates
Carbaryl bait

- Efficacy
- Resistance problems
- IPM Issues
- REI - 12
- PHI – 7 days
- Export/import issues – none?

- Why used /not used?

Methomyl
- Efficacy
- Resistance problems
- IPM Issues
- REI - 48
- PHI – 1 day
- Export/import issues – none?
- Why used /not used?

Other - pyrethroids
Cyfluthrin – Baythroid 2
- Efficacy
- Resistance problems
- IPM Issues
- REI - 12
- PHI – 0 day
- Export/import issues – none?
- Why used /not used?

Esfenvalerate – Asana XL
- Efficacy
- Resistance problems
- IPM Issues
- REI - 12
- PHI – 7 days
- Export/import issues – none?
- Why used /not used?

Pest Management Concerns
Trapping to determine timing of insecticide applications

Pipeline pest management tools

To do

*Regulatory*

*Research*

*Education*
- As new management tools become available, provide training on use
- Stress importance of weed-free fields

## *4) Aster leafhopper*

Not usually considered to be a problem for vectoring aster yellows, in sharp contrast to the aster yellows situation in Michigan.

Insecticides for leafhopper control

Organophosphates
Malathion
- Efficacy
- Resistance problems
- IPM Issues
- REI - 12
- PHI
- Export/import issues – none?
- Why used /not used?

Carbamates
Methomyl
- Efficacy
- Resistance problems
- IPM Issues
- REI - 48
- PHI – 1 day
- Export/import issues – none?
- Why used /not used?

Pyrethroids
Esfenvalerate – Asana XL
- Efficacy
- Resistance problems
- IPM Issues
- REI - 12
- PHI – 7 days
- Export/import issues – none?
- Why used /not used?

Chlorinated Hydrocarbons
Methoxychlor
- Efficacy
- Resistance problems
- IPM Issues
- REI - 48
- PHI
- Export/import issues – none?
- Why used /not used?

Pest Management Concerns

Pipeline pest management tools

To Do

*Regulatory*

*Research*

*Education*

*IR-4 Materials either Potential or Pending for Insect Control*
Fipronil – phenylpyrazole neurotoxin
Flonicamid – nicotinamide
Thiacloprid – neonicotinoid
Zeta-cypermethrin – pyrethroid
Methoxyfenozide – molting accelerator
Bistrifluron – benzoylphenyl urea
Chromafenozide – insect growth regulator
Metarhizium anisopliae – fungus?
Bifenthrin – pyrethroid
Thiamethoxam – neonicotinoid
Spinosad – macrocyclic lactone

==========

# Disease Pests

Two of the three carrot growers rely upon Tomcast, a computer program used to forecast optimal periods of disease pathogen activity, for applying fungicides to manage alternaria and cercospora leaf blights. The disease severity values were produced by equipment operated by Steve Johnston and others. The information is provided to Violet Packing Company which makes the information available to carrot and tomato growers via a dial-up codaphone.

## *1) Bacterial leaf blight*

*Xanthomonas campestris* pv *carotae*. This disease is occasionally seen in New Jersey carrots. The primary source of infection is seed contamination. Depending upon the amount of contamination, wet conditions cause the disease to flare up. Excessive rainfall or irrigation after planting may be sufficient to initiate the disease. Brown lesions occur initially in the forked areas of the leaves and may cause the whole leaves to wilt, significantly reducing yields. Once detected on the foliage, copper fungicides can be applied to slow the disease spread.

*Threshold* – Presence of disease in the field.

Bactericides
Fixed coppers

- Efficacy
- Resistance problems
- IPM Issues
- REI – 12,24,48 hr
- PHI – 0 day?
- Export/import issues – none?
- Why used /not used?

Mefenoxam + copper (Ridomil Gold with Copper)

- Efficacy
- Resistance problems
- IPM Issues
- REI - 12,24,48 hr
- PHI – 0 day?
- Export/import issues – none?
- Why used /not used?

Pest Management Concerns

- Field scouting
- Post harvest tillage to reduce crop residue

Pipeline pest management tools

To Do

*Regulatory*

*Research*

- Establish disease severity
- Develop seed testing and treatment
- Develop contaminated seed threshold

*Education*

- Educate growers on disease symptoms and identification

## *2) Alternaria and Cercospora leaf blights*

*Alternaria dauci (= A. porri f sp. dauci).* This is a common fungal disease that sometimes can be confused with bacterial blight because of similar foliar lesions. The brownish-black lesions often have a yellow halo about the lesion. Once lesions occupy about 40% of the leaf the leaf wilts and dies. Seedlings may become infected and often die becoming a source for spore release. Moderate temperatures and prolonged leaf wetness favors disease development. Most infections come from contaminated seed but spores may be wind blown and new infections may occur in fields downwind from other infected fields. Soilborne infections may occur but annual crop rotation appears to prevent this type of infection.

*Cercospora carotae*. In contrast to Alternaria leaf blight, Cercospora blight tends to infect younger foliage and often precedes Alternaria infections. Lesions begin as brown flecks on the foliage which increase in size turning tan with yellow halos. Lesions occurring along the leaf margins are elongate and lesions occurring inside away from the margins are more circular. Foliar lesions may coalesce causing the leaves to curl and whither. Stem lesions which are elliptical also occur. Contaminated seed and spores arising from wild species of Daucus are the primary sources of infection but spores can be easily transported by contact by man or machine or splashing water either as irrigation or rain.

*Threshold* - Presence of disease in the field, or presence of optimal weather conditions.

Strobilurins

Pyraclostrobin (Cabrio)

- Efficacy
- Resistance problems
- IPM Issues
- REI - 12
- PHI – 0 day
- Export/import issues – none?
- Why used /not used?

Azoxystrobin (Quadris)

- Efficacy
- Resistance problems
- IPM Issues
- REI - 12
- PHI – 0 day
- Export/import issues – none?
- Why used /not used?

<u>Other</u>

Chlorothalonil – B2 carcinogen

- Efficacy
- Resistance problems
- IPM Issues
- REI - 12
- PHI
- Export/import issues - none
- Why used /not used?

Iprodione

- Efficacy
- Resistance problems
- IPM Issues
- REI - 12
- PHI
- Export/import issues – none?
- Why used /not used?

<u>Pest Management Concerns</u>

Field scouting
Crop residue management
Maintaining non-strobilurin fungicides

<u>Pipeline pest management tools</u>

<u>To Do</u>

*Regulatory*

*Research*

- Determine efficacy and use patterns of reduced risk fungicides and biocontrol agents
- Optimize fertilization program for enhanced foliar vigor, blight resistance and late season foliage growth
- Determine the efficacy of coppers used alone and alternated with strobilurins and other new chemistries
- Develop resistance programs for fungicides
- Identify effective product suitable for use as a seed treatment
- Test other fungicidal materials incorporating sulfur
- Evaluate and incorporate other fungicide classes into the Tomcast program

*Education*

### *3) Crown Rot*

*Rhizoctonia solani*. Crown rot is occasionally seen in mature carrots near harvest. Root infections are favored by wet soil and moderate temperatures. Lesions are dark brown and sunken occurring near the crown or further down the carrot. Sometimes these lesions may be confused with insect injury. If the lesions are severe enough the stricken carrots may not be marketable. Crop rotation is one of the best ways to avoid severe problems with crown rot. Carrots probably should not be planted following alfalfa or other crops typically susceptible to Rhizoctonia infections.

*Threshold* – None established.

<u>Fungicides</u>
Mefenoxam

- Efficacy - ?
- Resistance problems
- IPM Issues
- REI - 0
- PHI
- Export/import issues – none?
- Why used /not used?

<u>Pest Management Concerns</u>
Crop rotation
Field scouting

<u>Pipeline pest management tools</u>

<u>To Do</u>

*Regulatory*

*Research*

*Education*

### *4) Root Dieback*

*Pythium spp.* Root dieback occurs when any damage occurs to the main taproot of the plant including biotic and abiotic conditions. When the root tip is damaged it loses its apical dominance and other root tips develop ultimately causing forked or stubby roots. The soilborne Pythium fungi also contribute to the incidence of root dieback. Disease caused root dieback most often occurs in moist soil.

*Threshold* – None established.

Pest Management Concerns
Field scouting

Pipeline pest management tools

To Do

*Regulatory*

*Research*

*Education*

### *5) Aster yellows*

A *mycoplasma-like organism*. This disease is common among herbaceous plants and vegetables in the mid-West but is relatively uncommon in New Jersey. In carrots it is a relatively minor disease because carrots generally seem to be resistant to some degree plus the vectoring leafhoppers appear to have a very low level of infectivity. The incubation period in the plant is fairly long also so that plants that become infected within two weeks of harvest will show no symptoms by harvest. The pathogen is vectored primarily by the aster leafhopper. Other leafhoppers vector it but not as well. Infected plants become yellowish with a proliferation of twisted leaves and petioles which will easily break off. Masses of new roots develop but eventually the plant dies. Plants exhibiting symptoms are unmarketable.

*Threshold* – None established.

Pest Management Concerns
Disease best managed by controlling the aster leafhopper

Pipeline pest management tools

To Do

*Regulatory*

*Research*

*Education*

*IR-4 Materials either Potential or Pending for Disease Control*
Fenamidone – respiration inhibitor

Boscalid BAS 510 - nicotinamide
Fluazinam – pyridinamine
Nocobifen BAS 510 – nicotinamide
Famoxadone – Oxazolidinedione
Ipconazole – triazole
Streptomyces lydicus WYEC 108 – bacterium
Gliocladium catenulatum strain 11446 – fungus
Glutamic acid – acidic amino acid
Ampelomyces quisqualis isolate M 10 – fungus
Muscodor albus – biofungicide
Bacillus subtilis – microbial
Bacillus pumilus strain 2808 – microbial
Bacillus subtilis strain QST 713 – microbial
Coniothyrium minitans – fungus
Cyprodinil/Fludioxonil – a pyrimidine and pyrrole
Propamocarb hydrochloride – carbamate systemic
Propiconazole – triazole
Trifloxystrobin – strobilurin

==========

# Nematode Pests

## *Root knot nematode*

*Meloidogyne* spp. probably *hapla*. Root knot nematode has been a significant pest of carrots in southern New Jersey. The nematode causes distortion of the root system including swollen gall or knots by the feeding activities of mature nematodes. Both males and females develop on the roots, however the females stay inside the roots while the males remain active outside. The female retains the eggs which ultimately hatch. The young nematodes live freely for awhile in the soil and then return to a suitable host to feed upon. There may be as many as three generations per growing season.

Severely infested plants are stunted or killed during germination and may produce small or unmarketable carrot roots. Sandy soil is more conducive to root knot nematode presumably because of the larger pore spaces facilitates their movement when the soil is moist. Yield reductions can be severe. Crop rotation may be of benefit especially if small grains are grown in root knot infested fields. However, root knot nematode has many host plants and elimination of this nematode from a field using crop rotation alone would be difficult.

*Threshold* – Presence of nematodes in a soil sample prior to planting.

<u>Carbamates</u>
Metam sodium (Vapam HL) – B2 carcinogen (EPA)

- Efficacy
- Resistance problems
- IPM Issues
- REI - 48
- PHI

- Export/import issues – none?
- Why used /not used?

Chlorinated Hydrocarbons
Dichloropropene? (Telone) – B2 carcinogen (EPA)
- Efficacy
- Resistance problems
- IPM Issues
- REI - 72
- PHI
- Export/import issues – none?
- Why used /not used?

Pest Management Concerns
- Crop rotation
- Field scouting
- Use and results of nematicidal cover crops may be inconsistent
- Concern with resistance of nematodes to nematicides
- Losing Telone and Vapam due to regulatory issues

Pipeline pest management tools
IR 4 materials - potential
Iodomethane – methyl iodide
AKD-3088
Terrapy – fatty acid in polyglycoside

To Do
*Regulatory*
- Post-plant use of Vydate?

*Research*
- Determine effects of soil amendments such as crab meal and other chitinous materials, municipal leaves
- Develop precision agriculture technology to identify and treat problem areas
- Determine soil quality that minimizes nematode problems

*Education*
- Stress soil sampling of unknown fields for presence of nematodes

==========

# Weed Pests

*1) Winter annuals* – generally not a problem
*2) Summer annuals* – certain species are problematic depending upon the stage of growth when herbicides are applied

Trifluralin (Treflan HFP) - EPA C carcinogen

- Efficacy
- Resistance problems
- IPM Issues
- REI – 12,24
- PHI
- Export/import issues – none?
- Why used /not used?

Linuron (Linex 4L) – EPA C carcinogen

- Efficacy
- Resistance problems
- IPM Issues
- REI – 24
- PHI
- Export/import issues – none?
- Why used /not used?

Clethodim (Select)

- Efficacy
- Resistance problems
- IPM Issues
- REI – 12,24
- PHI
- Export/import issues – none?
- Why used /not used?

Metribuzin (Sencor) – EPA D carcinogen

- Efficacy
- Resistance problems
- IPM Issues
- REI - 12
- PHI
- Export/import issues – none?
- Why used /not used?

Fluazifop (Fulsilade)

- Efficacy
- Resistance problems
- IPM Issues
- REI - 12
- PHI
- Export/import issues – none?
- Why used /not used?

Sethoxydim (Poast)

- Efficacy
- Resistance problems
- IPM Issues
- REI – 12,24
- PHI
- Export/import issues – none?
- Why used /not used?

Pest Management Concerns

- Given the general nature of weed problems the current herbicide selections fit well with an IPM approach
- Field scouting
- Hand weeding
- Potential loss of linuron as no suitable replacement for weed control

Pipeline pest management tools
S-metolachlor (Dual Magnum)?
Pendimethalin (Prowl)?

To Do

*Regulatory*

*Research*

- Determine the value of mulching and composting as weed management aids
- Develop innovative mechanical weed control methods
- Determine the efficacy of strip tillage with banded application of herbicides in managing weeds

*Education*

## *3) Dodder*

*Cuscuta sp.* Dodder is a parasitic plant deriving its water and nutrient needs from other plants. Shortly after germination and emergence the dodder plant begins its parasitic existence complete with the withering of the stem and roots. Dodder prefers moist field conditions and will form mats of orange tendrils which often cover host plants. Dodder can reduce yields but seldom causes serious problems. One farmer will pull dodder off of the carrots and another farmer spot sprays paraquat on dodder infestations.

Herbicides

Glyphosate (Round-up)

- Efficacy
- Resistance problems
- IPM Issues
- REI - 24
- PHI
- Export/import issues – none?
- Why used /not used?

Paraquat

- Efficacy
- Resistance problems
- IPM Issues
- REI – 12,48
- PHI
- Export/import issues – none?
- Why used /not used?

Pest Management Concerns

Spot spraying

Pipeline pest management tools

To Do

*Regulatory*

*Research*

*Education*

*IR-4 Materials either Potential, Pending*

Flucarbazone-sodium – ALS inhibitor
Carfentrazone-ethyl – PPO inhibitor
Pelargonic acid – fatty acid
Colletotrichum gloeosporiodes – fungus
Flumioxazin – PPO inhibitor

==========

# Vertebrate Pests

## *1) Deer*

Damage carrots by eating tops, pulling carrots up (?), and trampling by hooves.

To Do

*Regulatory*

*Research*

*Education*

- Review the latest in deer repellants to see if something is applicable to carrots

## *2) Woodchucks/groundhogs*

Woodchucks graze the tops of the carrots near their burrows, greatly reducing yields in affected areas.

Pest Management Concerns
Clearance of fencerows
Interference with pest monitoring tools, especially bait traps for carrot weevils

To Do

*Regulatory*

*Research*

*Education*

# REFERENCES