

Crop Profile for Onions in New York

Prepared: May, 1999

General Production Information



Onions are one of the most important vegetable crops in New York in terms of crop value. The principle type of onion grown is the pungent yellow globe, and most are produced on muck (high organic matter) soils. Costs of production are higher for onions than any other vegetable crop in New York. Several insects and numerous diseases attack onions, and control of these currently relies on the frequent use of pesticides. Because onions compete poorly with weeds, weed control is an important and costly management issue. Without the registration of new effective materials to replace them, the loss of chlorpyrifos (for onion maggot control); the fungicides chlorothalonil, maneb, mancozeb, or iprodione; and the herbicides pendimethalin, metolachlor, oxyfluorfen, bromoxynil, clethodim, or fluzifop p-butyl, would have significant impacts on production and profitability. In addition, the industry has critical needs for the following (not in prioritized order): 1) federal and state registration of cyromazine for onion maggot control; 2) availability of effective, non-pyrethroid insecticides for resistance management in onion thrips; 3) federal and state registration of dimethenamid for control of yellow nutsedge; 4) federal and state

registration of oxamyl or another effective nematode control; 5) effective controls for bulb mites and bacterial diseases; and 6) more effective controls for smut.

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.

Basic Commodity Information

State Rank: 6

% U.S. Production: 5.7%

Acres Planted: 12,500

Acres Harvested: 12,200

Cash Value: \$39,276,000

Yearly Production Costs: \$2654 (estimated, 1993)

Commodity Destination(s):

- o **Fresh Market:** 98%
- o **Processing:** 2%

Production Regions: Onions are primarily grown on muck (organic) soils found in Orange, Oswego, Orleans, Genesee, Madison, Wayne, Yates, and Steuben counties.

Cultural Practices

Onions are mostly direct seeded in the field although some are transplanted as seedlings or sets. Transplants are sometimes used to improve bulb size, to hasten maturity, or to avoid infection by some plant diseases, but this method of crop establishment is more expensive. Planting occurs from late March through early May. Most onions are grown on muck soils, however some onions are being successfully grown on well-drained mineral soils with supplemental irrigation and fertilizer. Because of their very high cost of production, high value, and specialized soil type needs, onions are not always rotated with other crops.

Between-row spacing varies considerably depending upon weed and foliar disease management, seeder capability, and harvesting equipment. Within-row spacing also varies depending upon variety, desired bulb size, between row spacing, soil type, and other management considerations. The use of irrigation is increasing in most of the onion producing regions of the state.

Barley windbreaks are typically planted on muck soils at the same time as onion seeding. Barley emerges and grows much more quickly than onions, providing protection against wind erosion and subsequent onion seedling damage. Once the onions are established, the windbreaks are killed with a selective herbicide. Wind damage can be significant, and total crop loss due to winds in May or early June is not rare.

Once onion leaves have senesced and the necks have sealed, bulbs can be harvested. About 7 days prior to harvest, bulbs are undercut to hasten the process. The mature onions are then lifted and the tops are cut to leave about 2 inches of neck. This ensures a tight seal after drying and curing to prevent the invasion of storage pathogens. The bulbs are harvested into trucks and may be further cured with forced air and a drying temperature of 85-90°F, before being placed in storage. A high percentage of onions grown in NY are stored for marketing throughout the fall, winter, and early spring. For long-term storage, the sprout inhibitor maleic hydrazide is used just before onions are undercut (approximately 60% crop treated; 2 lb ai/acre).

In Orange County, many growers produce some of their own onion seed for certain varieties of early maturing onions. After storage over winter, bulbs are selected for size and disease-free status, and planted in small plots located away from the main onion crop. Pests in seed onions are managed in a similar manner to the main crop, although fungicides may be used more frequently in order to minimize seed-borne diseases.

Insect Pests

Onion Maggot (*Delia antiqua*)

Frequency of Occurrence: Annually.

Damage Caused: Onion maggot larvae feed on the belowground hypocotyl tissue of seedlings, resulting in a variety of damaging symptoms. Larval feeding may kill seedlings; therefore, poor plant stands may indicate an onion maggot problem. In larger plants, larvae may tunnel into the bulb causing plants to become flaccid and yellow. Later generations damage bulbs, often causing them to rot, and rendering them unfit for sale or consumption.

% Acres Affected: 100%

Pest Life Cycles: Onion maggots are highly host-specific to plants in the onion family. The insect overwinters as pupae in the soil associated with onion culls in the field or in onion cull piles. Adults emerge about mid-May and mate over a three-day period after which they begin laying their tiny white eggs at the base of the plant. The larvae, upon emergence, crawl beneath the leaf sheath and enter the bulb. The onion maggot pupates in the soil and the subsequent generation of adults appears 3-4 weeks later. There are 3 generations of onion maggot per season. The first generation is often the largest and most damaging. The third generation attacks onions in mid-August shortly before harvest. Feeding damage at this time can lead to storage rots as onion maggots can introduce bacteria into the feeding wounds.

Timing of Control: planting through harvest

Yield Losses: Stand losses as high as 90% can be seen in untreated areas. Even with the use of insecticides, losses typically

run 2-10% per year, between stand losses and direct damage to bulbs.

Cultural Control Practices: Crop rotation can be very effective, but must provide at least one mile of separation between new seedings and previous crops or cull piles. This is frequently impractical since onions are grown by a number of producers in large contiguous "pockets" of muck soil. There are no commercial varieties with resistance, although a few show some limited tolerance to the third generation. Because adult flies are attracted to damaged onions, minimizing herbicide or mechanical damage can be helpful. Growers sometimes increase seeding rates to compensate for losses, but this can lead to non-uniform stands and bulb size, since seedling loss occurs in patches, not uniformly over a field.

Regional Differences: While this pest is very serious in all onion growing regions, it can be particularly devastating in cooler growing areas such as Oswego, Wayne and Yates Counties.

Biological Control Practices: Onion maggots have several natural enemies that can be protected with the judicious use of insecticides. Barley windbreaks may attract natural enemies and provide sites for flies infected with pathogenic fungi to congregate and infect other flies. Knowledge is lacking on how effective natural enemies can be, and on ways to increase their efficacy.

Post-Harvest Control Practices: Cleaning up all cull and volunteer onions out of fields before planting can make a field less attractive to adults. Fall plowing will reduce the populations of overwintering pupae.

Other Issues: Because onion maggot is such a serious pest of onion in NY, research on its control is on-going (Eckenrode and Straub). New insecticides are being screened (see Alternatives section), cultural controls tested, and resistance patterns tracked. Efforts are underway to locate genetic resistance to onion maggot in onion and its relatives and move it into commercial varieties, but this type of control strategy is still years, perhaps decades, away. *Bacillus thuringiensis* (Bt) bait sprays have been field tested in small plots over the past two years (van der Heide and Bornt). Results suggest that this approach will not control the 1st generation, but may be useful for control of later generations.

Chemical Controls for 1st Generation Onion Maggots:

Pesticide	% Trt. ¹	Type of Appl.	Typical Rates lbs ai/acre	Timing	# of Appl.	PHI ² days	REI hours
chlorpyrifos <i>(Lorsban)</i>	95	In-furrow drench	1.0	At planting	1	120	24
cyromazine ³ <i>(Trigard)</i>	5	Commercial seed treatment	0.26 (=50 g/kg seed)	Before planting	1	120	NA

1. Estimates of percent acreage treated with chlorpyrifos and cyromazine are for 1996-1998. It is expected that in 1999, percentage acreage treated with chlorpyrifos will decrease to approximately 80% and that treated with cyromazine will increase to 35%. As producers become more familiar with cyromazine, and assuming it continues to be available, it is expected that these numbers will continue to change.

2. PHI on this and all tables indicates the typical number of days between application and harvest, not label PHIs.

3. Available through a Section 18 label for California, where seeds are treated.

Several foliar insecticides are registered and used for adult onion maggot control, usually in conjunction with insecticide applications for thrips control. See "Onion Thrips" section for pesticide use information.

Use in IPM Programs: Use of chlorpyrifos or cyromazine is consistent with Cornell IPM recommendations. Foliar insecticides for fly control during later generations are not recommended unless the field suffered considerable first generation damage.

Use in Resistance Management: The onion maggot has displayed a marked ability to develop resistance to insecticides. Resistance to chlorpyrifos has been documented in a number of onion growing areas, and while it is still at relatively low levels, the problem is becoming more widespread.

Alternatives: The onion industry is in dire need of effective alternatives to chlorpyrifos, and until at least two are registered and available for use, producers must depend on chlorpyrifos for onion maggot control. While diazinon is labeled for use, it does not provide commercially acceptable levels of control. Federal registration of cyromazine seed treatment would be a first step, but more options are needed. Cyromazine (an insect growth regulator) can be very effective, but this is somewhat weather dependent. Cyromazine may also affect the germination of seed carried over from the previous season, a common practice among producers. Fipronil (applied as a seed treatment at 0.04 lbs ai/acre) has been tested over several years in field trials and appears to be highly effective against this pest. One experimental material (EXP80572B) showed promising results in 1998 trials. A new material, thiomethoxam (Adage) from Novartis, may also prove to be a useful alternative. Research is planned for 1999.

Efficacy Issues: Efficacy of Lorsban is becoming compromised because of resistance problems. Cyromazine can be very effective, except when weather is very dry. Foliar sprays are of questionable efficacy since they must contact the adult, and flies migrate in and out of fields.

Onion Thrips (*Thrips tabaci*)

Frequency of Occurrence: Annually.

Damage Caused: Thrips are often found between the leaf sheath and stem on onions where they are out of reach of insecticides and many natural control agents. Thrips primarily damage crops directly by their rasping and feeding activities, causing whitish blotches on leaves. Severe damage to onions will cause leaves to senesce prematurely and bulbs to become distorted or remain undersized. Hot, dry weather is correlated with occurrence of severe thrips problems.

% Acres Affected: 100%

Pest Life Cycles: Thrips are a very important annual pest of onions. Adults and nymphs overwinter on plants or debris or along weedy field edges. The females can reproduce without mating and lay eggs beneath the leaf surface. Eggs hatch after 5-10 days and nymphs are fully-grown after 15 to 30 days. Development of the last two nymphal stages occurs in the soil, without feeding. After the 4th molt, adult female thrips return to the plant. There are usually 5-8 generations per year, and they have a relatively wide host range.

Timing of Control: mid- to late summer

Yield Losses: Up to 50% in severely affected fields.

Cultural Control Practices: Heavy rain or overhead irrigation can reduce thrips populations. Some older onion varieties with more open canopy growth tend to have fewer thrips.

Regional Differences: None.

Biological Control Practices: Onion thrips have several natural enemies. Their effectiveness can be improved by applying insecticides judiciously.

Post-Harvest Control Practices: None.

Other Issues: Research on thrips biology, control, and patterns of resistance is ongoing (Eckenrode and Straub).

Chemical Controls for Onion Thrips and Onion Maggot Adults:

Pesticide	% Trt. ¹	Type of Appl.	Typical Rates lbs ai/acre	Timing	# of Appl. ²	PHI days	REI hours
azinphos-methyl <i>(Guthion)</i>	5	Ground, foliar. Sometimes by air.	0.75	mid-June to late August	1	28	48
diazinon <i>(Diazinon)</i>	<1	Ground, foliar. Sometimes by air.	0.5	mid-June to late August	1	14	24
methomyl <i>(Lannate)</i>	<5	Ground, foliar. Sometimes by air.	0.45	mid-June to late August	1	7	48
methyl parathion <i>(Penncap-M)</i>	<5	Ground, foliar. Sometimes by air.	0.5	mid-June to late August	1	15	48
permethrin <i>(Ambush, Pounce)</i>	50	Ground, foliar. Sometimes by air.	0.125	mid-June to late August	1-3	14	12
cypermethrin <i>(Ammo)</i>	50	Ground, foliar. Sometimes by air.	0.08	mid-June to late August	1-3	14	12
zeta-methrin <i>(Mustang)</i>	20	Ground, foliar. Sometimes by air.	0.05	mid-June to late August	2-3	14	12
lambda-cyhalothrin <i>(Warrior)</i>	98	Ground, foliar. Sometimes by air.	0.02	mid-June to late August	3-5	14	24

1. Foliar insecticide use has changed considerably since the introduction of lambda-cyhalothrin in 1997. Resistance problems suggest that the current high level of reliance on this pyrethroid may result in more changes in use patterns in the near future. Cross-resistance to other pyrethroid chemistries is likely.

2. The number of applications varies considerably from year to year among different producers and growing regions. Early maturing varieties of onions typically receive fewer applications than late season varieties. During hot dry seasons, as many as 12 insecticide sprays may be used in one growing season. In years with low thrips pressure, as few as 1-2 may be used.

Use in IPM Programs: A scouting protocol and economic thresholds have been established. The registration of more effective pyrethroids (e.g. lambda-cyhalothrin) in the past few years has made producers more comfortable with the use of thresholds. Growers are recommended to alternate between different classes of insecticides for resistance management.

Use in Resistance Management/Efficacy Issues: Pyrethroids have been used frequently for thrips control during the past decade, and in recent years resistance to lambda-cyhalothrin has been documented (Eckenrode). In a number of field trials, pyrethroids such as cypermethrin and lambda-cyhalothrin have been shown to lose their effectiveness within a growing season. For this reason, it is critical to have a number of insecticides from different classes registered for onion thrips control in order to minimize thrips resistance to pyrethroids.

Alternatives: A new material, chlorfenapyr (Alert), has shown promising results in recent field trials. Spinosad, applied at the 0.178 lbs ai/acre rate) has also provided good thrips control in field trials. IR-4 has scheduled residue trials on spinosad

in onions for 1999. Thiamethoxam (Adage), a new insecticide from Novartis, may be an effective alternative, and trials are planned for 1999.

Bulb Mite (*Rhizoglyphus robini*)

Frequency of Occurrence: Sporadic, but potentially very damaging.

Damage Caused: Most damage occurs at the roots and basal plate. The aboveground symptoms of damage are similar to those of the onion maggot. Damage is most serious to seedling onions. Heavily damaged plants lose their roots and collapse. There may be a significant interaction between bulb mite and onion maggot damage.

% Acres Affected: up to 40%

Pest Life Cycles: Very little is known about the biology of this soil-dwelling mite that has become a pest of significance over the past three or four years. Bulb mites have a very wide host range, but barley seeds seem to be a preferred food item. Mite populations were found to be higher in plots with a barley or rye windbreak than plots with tall fescue or ryegrass in one study. Barley is currently preferred by onion growers for use as a winter cover-crop and spring wind-break.

Timing of Control: Unknown.

Yield Losses: Can be up to 50% in severely affected fields.

Cultural Control Practices: Remove volunteers, destroy onions in cull piles, and restrict onion seed production near onion production areas.

Regional Differences: Economic damage has so far been limited to Orange County, although it can be found at sub-economic levels in other onion growing regions in the state.

Biological Control Practices: Unknown.

Post-Harvest Control Practices: Remove all bulbs remaining in the fields after harvest as these are overwintering sites and also can increase mite buildup in the spring.

Other Issues: The industry is in great need of effective control measures for this pest. Research on the biology and control of this new pest is ongoing (Eckenrode and Straub). In field trials, oxamyl and formetanate hydrochloride, as in-furrow drenches and as seed-treatments, have shown some efficacy against this pest. Postharvest fumigation with metam sodium (100 gallons per acre) has some suppressive effect, but cost-effectiveness is in question.

Chemical Controls: None labeled.

Cutworms (*Agrostis ipsilon* and others)

Frequency of Occurrence: Sporadic.

Damage Caused: Most species of cutworms sever the seedling just above or below the soil line and pull the plant into the ground as they feed.

% Acres Affected: 100% at risk; up to 5% affected per year.

Pest Life Cycles: Cutworm adults are small, dark gray or brown moths with lighter colored hindwings. The eggs are laid on plants or on the soil surface. The larvae are usually yellow, brown, or gray. They curl into a characteristic C-shape when disturbed.

Timing of Control: May through June.

Yield Losses: Up to 75% in severely affected fields.

Cultural Control Practices: Cultivation to destroy weeds and other vegetation ten days before planting may reduce the number of larvae.

Regional Differences: None.

Biological Control Practices: Cutworm larvae have several natural enemies. Avoid unnecessary sprays to conserve the natural enemy populations.

Post-Harvest Control Practices: None.

Chemical Controls:

Pesticide	% Trt.	Type of Appl.	Typical Rates	Timing	# of Appl.	PHI days	REI hours
methomyl <i>(Lannate)</i>	<5%	ground, soil	0.45 lbs ai/acre	seedling stage	1	110	48
permethrin <i>(Ambush)</i>	<5%	ground, soil	0.3 lbs ai/acre	seedling stage	1	110	12

Diseases

Damping-Off (*Pythium* spp.)

Frequency of Occurrence: Commonly found throughout the growing areas; degree of economic significance varies considerably.

Damage Caused: Seeds may rot and fail to germinate or newly emerged seedlings may rot at the soil line and wilt or collapse. The roots and shoots of surviving seedlings may have a brown rot and fail to thrive.

% Acres Affected: 100% at risk; up to 40% affected per year.

Pest Life Cycles: These soil-borne fungi have a wide host range and can survive in soil for many years as oospores. They are most damaging to onions during cool wet weather. The pathogens can be seed-borne.

Timing of Control: Planting and seedling stages.

Yield Losses: Can be as high as 30% in severely affected fields.

Cultural Control Practices: Spanish-type onions are more susceptible than pungent storage types. Plant disease-free seed treated with an appropriate fungicide. Grow transplants in steam-sterilized soil or soilless mix to ensure freedom from the disease.

Regional Differences: Tends to be a more significant problem in cooler growing areas (Oswego, Wayne, Yates and Steuben Counties).

Biological Control Practices: None.

Chemical Controls: Mefenoxam (Ridomil Gold) is used on 1-5% of onion acreage. It is applied pre-plant incorporated, at a rate of 1 pint of product per acre. Thiram + carboxin (Pro-Gro seed treatment) also provides some control of damping-off (see "Smut" section, below).

Smut (*Urocystis colchici*)

Frequency of Occurrence: Annually.

Damage Caused: The fungus penetrates the cotyledons of developing seedlings. As the disease progresses, pustules develop which later rupture, releasing spores that re-contaminate the soil. The first symptoms of onion smut appear as brown to black elongated blisters on cotyledons and young leaves. A single lesion may cover an entire leaf causing it to curve downward. The fungus progresses inward from leaf to leaf at the base of the plant. Most infected seedlings die within 3-5 weeks after germination. This is an early and important feature of the smut injury. Plants are usually stunted and may die slowly through a gradual drying out process. If plants survive, the disease becomes systemic. Symptoms of systemic infection are plants, which remain vegetative for the entire growing season. If bulbs form, they also become covered with blackish lesions and are open to attack by secondary organisms. Smut does not cause a rot during storage, but smutted bulbs shrink more rapidly and are more subject to attack by other organisms than healthy ones.

% Acres Affected: 100%

Pest Life Cycles: The smut fungus survives in the soil for many years as multi-celled spores. These spores are highly resistant to environmental change and may remain dormant in the soil for many years. In the presence of a new onion crop the spores germinate. Onions are susceptible to infection by the smut fungus shortly after germination and remain susceptible through the development of one true leaf.

Timing of Control: Before and at planting.

Yield Losses: Up to 40% in severely affected fields.

Cultural Control Practices: Crop rotation can reduce the buildup of smut inoculum, but is not always practical. No resistant varieties are available. Planting disease-free seed, and planting no more than ¼ inch below the soil surface may be helpful.

Regional Differences: While all growing areas are affected, those in the cooler regions (i.e. Oswego County) have higher disease pressure.

Biological Control Practices: None.

Chemical Controls:

Pesticide	% Trt.	Type of Appl.	Typical Rates lbs ai/acre	Timing	# of Appl.	PHI days	REI hours
thiram + carboxin¹ (<i>Pro-Gro</i>)	10-20	commercial seed treatment	label rates	before planting	1	120	--
maneb (<i>Maneb, Manex</i>)	30-40	in-furrow drench	2.25	at planting	1	110	24

mancozeb <i>(Dithane)</i>	50-60	in-furrow drench	2.25	at planting	1	110	24
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1. 50% thiram and 30% carboxin.

Use in IPM Programs: Use of each of these materials is consistent with Cornell IPM recommendations. Without the availability of the EBDC fungicides, or other effective new materials, onions could not be grown profitably in NY because of losses to smut.

Use in Resistance Management: None reported.

Efficacy Issues: Available chemical controls are not always adequately effective, especially the Pro-Gro seed treatment Research from Canada suggests that mancozeb in a granular form may be more effective than in a drench form.

Alternatives: None at this time.

Botrytis Leaf Blight (*Botrytis squamosa*)

Frequency of Occurrence: Annually.

Damage Caused: causes a destructive disease of onion that is commonly found in most onion fields. The disease kills foliage and spreads so rapidly that growers gave it the name "blast". Onion plants are predisposed to blast by other diseases, insect damage, mechanical injury, and air pollution damage. Ozone air pollution aggravates infection by the leaf blight pathogen. Extended periods of leaf wetness are necessary for infection and the extent of the leaf blight is directly related to the length of time that the foliage remains wet.

% Acres Affected: 100%

Pest Life Cycles: The fungus survives in the soil and on plant refuse as small black bodies called sclerotia. During hot, humid weather sclerotia give rise to airborne spores. These lodge on wet onion foliage, germinate, and enter the plants through wounds. Symptoms of the disease appear first on the oldest leaves as oval whitish or yellowish spots approximately 1-3 mm long, slightly depressed and bordered with a diffuse silver halo. If the leaf is sliced open, it can be seen that the lesions extend through the thickness of the leaf blade. When conditions favor spread, the disease progresses rapidly and numerous lesions appear on each leaf. Foliage may be severely damaged with substantial reductions in yield. Onions appear to be highly susceptible to leaf blight during the early stages of bulbing. *Botrytis squamosa* can also proliferate in storage and cause a neck rot.

Timing of Control: mid- to late season.

Yield Losses: Up to 75% in untreated, severely affected fields. Under current management programs, losses to this disease are typically less than 5%.

Cultural Control Practices: To reduce incidence and severity of this disease, cull piles should be destroyed and volunteer onions should be rogued out of fields. Rotation is also helpful in managing this disease.

Regional Differences: Pressure tends to be greater in Orange County, where weather is frequently hotter and more humid.

Biological Control Practices: None.

Post-Harvest Control Practices: Severed onion tops should be removed from the field and destroyed.

Other Issues: Research on botrytis control is ongoing, and includes screening of new materials for efficacy and crop tolerance (Lorbeer).

Chemical Controls for Botrytis and Other Leaf Blights:

Pesticide	% Trt.	Type of Appl.	Typical Rates lbs ai/acre	Timing	# of Appl. ¹	PHI days	REI hours
chlorothalonil <i>(Bravo)</i>	100	Ground, foliar. Sometimes by air.	0.75-1.5	from mid-season to before harvest	6-8	21	48
iprodione <i>(Rovral)</i>	40-50	Ground, foliar. Sometimes by air.	0.25-0.5	from mid-season to before harvest	3-4	14	12
maneb <i>(Maneb, Manex)</i>	50	Ground, foliar. Sometimes by air.	1.5	from mid-season to before harvest	5-7	7	24
mancozeb <i>(Dithane, Manzate)</i>	60	Ground, foliar. Sometimes by air.	2.0	from mid-season to before harvest	7-9	7	24
fixed copper <i>(Kocide & others)</i>	20	Ground, foliar. Sometimes by air.	varies with formulation	from mid-season to before harvest	1-3	7	48
vinclozolin <i>(Ronilan)</i>	40	Ground, foliar. Sometimes by air.	0.75-1.0	from mid-season to before harvest	1	18	12
mefenoxam² <i>(Ridomil Gold)</i>	5	Ground, foliar. Sometimes by air.	0.09	from mid-season to before harvest	1	7	48

1. The number of applications varies considerably from year to year among different producers and growing regions. Early maturing varieties of onions typically receive fewer applications than late season varieties. During warm wet seasons, as many as 12 fungicide sprays may be used in one growing season. In dry years, as few as 3-4 may be used.

2. For purple blotch control.

Use in IPM Programs: A well established IPM program for managing this disease based on scouting and disease forecasting is used by some producers. The program is management and capital intensive, but use of the IPM program usually saves at least one or two fungicide sprays compared to set spray schedules. Following recommendations, growers typically combine and rotate fungicides throughout the season.

Use in Resistance Management: None reported.

Alternatives: Tebuconazole (Folicur) may be an effective alternative, and IR-4 has scheduled residue trials for 1999. In recent trials, good levels of control have been achieved with the use of RH-141647 (experimental) and propiconazole (Tilt). Fluazinam has also shown good efficacy against botrytis, but the company has not been interested in pursuing a label for onions.

Efficacy Issues: Available fungicides are generally effective against this disease, especially when used in combination and in rotation.

Purple Blotch (*Alternaria porri*)

Frequency of Occurrence: Almost annually.

Damage Caused: Purple blotch may cause onion leaves to become blighted and die prematurely. The result is undersized and immature bulbs, thereby reducing yields. The destructiveness of the disease varies widely with locality and season, and depends upon how often and how long onion foliage is wetted by dew, fog, or showers. Yield increases of 20-35% or more have been recorded in fields sprayed with fungicides used to control purple blotch.

% Acres Affected: 100% at risk; up to 50% affected.

Pest Life Cycles: The fungus overwinters as mycelium in diseased plant debris and produces spores under favorable conditions in the spring. Initial symptoms appear as small, water-soaked, brownish areas on leaves, flower stalks, and floral parts of onions 1-4 days after infection occurs. As the spots enlarge, they assume a zonate appearance and become somewhat sunken and purplish in color. The lesion border is reddish or purple with a yellow halo that extends for some distance above and below the center of the lesion. Lesions may girdle the entire leaf. Onion bulbs may be infected at harvest or later in storage through the neck or through wounds in the bulb scales. The rot is semi-watery and yellow at first. The color gradually turns wine-red and finally dark brown or black. Diseased bulb tissue gradually dries out and becomes papery.

Timing of Control: mid- to late season.

Yield Losses: Up to 40% in untreated, severely affected fields.

Cultural Control Practices: Crop rotation (2-3 years) can break the cycle of infection, but is not often practical. Avoid harvest injuries to onions.

Regional Differences: None.

Biological Control Practices: None.

Post-Harvest Control Practices: Curing onions well will help reduce rots in storage. It is recommended to remove onion debris and host plants that may harbor the fungus after harvest.

Chemical Controls: Chlorothalonil, iprodione, maneb, mancozeb, fixed copper, mfenoxam and vinclozolin are all labeled for use as foliar applications to control this disease. See "Botrytis Leaf Blight" section for pesticide use patterns.

Use in IPM Programs: Use of these materials is consistent with Cornell IPM recommendations.

Use in Resistance Management: None reported.

Efficacy Issues: The effectiveness of iprodione and vinclozolin are improved when mixed with maneb, mancozeb, or chlorothalonil at half the normal rates.

Alternatives: Unknown.

Stemphylium Leaf Blight and Stalk Rot (*Stemphylium vesicarium* and *S. botryosum*)

Frequency of Occurrence: A relatively new disease in New York; has occurred sporadically over the past ten years.

Damage Caused: This leaf blight damages leaf area, stunts plants, and reduces bulb size. Infected onion leaves develop flecking and pale oval lesions that become brown as they expand. The lesions may kill entire leaves. Masses of black fungal spores eventually cover the lesions and flower stalk. The disease may often be found in combination with purple blotch (*Alternaria porri*).

% Acres Affected: up to 80% (estimated).

Pest Life Cycles: The life cycle of this disease in onions in NY is being investigated. It appears that both young and old onion leaves can be infected, but disease symptoms are most apparent on older leaves.

Timing of Control: mid- to late season.

Yield Losses: May be up to 40% in severely affected fields.

Cultural and Post-Harvest Control Practices: Routine sanitary practices such as the destruction of cull piles and the removal of volunteer onions may help reduce possible sources of this disease. At present, the most important source of the pathogen appears to be its transmission on onion seed.

Regional Differences: May be more of a problem in Orange County than other growing regions.

Biological Control Practices: None.

Chemical Controls: Several of the fungicides and fungicide combinations that control purple blotch and Botrytis leaf blight may control this disease. Mancozeb, iprodione, and chlorothalonil are recommended. See "Botrytis Leaf Blight" section for pesticide use patterns.

Efficacy Issues: Research has shown that mancozeb used at the high rate in combination with iprodione or chlorothalonil provides the best control.

Downy Mildew (*Peronospora destructor*)

Frequency of Occurrence: Sporadic but potentially serious.

Damage Caused: Infection occurs on leaves > 10 inches in length. Downy mildew may produce local lesions or it may be systemic. The older, outer leaves usually become infected first. Local infections appear as pale-green, oval to elongate slightly sunken lesions on leaves and seed stalks. In moist weather, these areas may be covered with a fuzzy, pale, purplish mold. Later the whole leaf may turn a dull pale green and then yellow. Systemically infected plants are stunted and have distorted pale green leaves. Under moist conditions, a fuzzy violet fungal growth develops over the entire leaf surface. Bulbs produced by affected plants are often smaller than normal.

% Acres Affected: up to 30%.

Pest Life Cycles: Downy mildew is a potentially serious disease of onions particularly when onions are grown under cool, moist, and humid conditions. The fungus overwinters as mycelium in infected onion bulbs left in field after harvest and cull piles. It may also persist in the soil to infect seedlings planted in the following season. Spores produced during the summer are carried by wind to infect new plants. Infection can spread very rapidly under cool, damp conditions.

Timing of Control: July through end of season.

Yield Losses: up to 50% in severely affected fields.

Cultural and Post-harvest Control Practices: The following practices help in disease management: removal and destruction of cull and volunteer onions; isolation of onions grown for seed; planting only mildew-free transplants; and rotation away from onions for two or more years.

Regional Differences: This disease is more serious in cooler growing areas (e.g. Oswego and Steuben Counties), and is rarely seen in warmer growing areas (e.g. Orleans or Orange County).

Biological Control Practices: None.

Chemical Control Practices: Mefenoxam, maneb, and mancozeb are generally effective on downy mildew. See "Botrytis

Leaf Blight" section for pesticide use patterns.

Use in IPM Programs: Disease forecasting programs based on weather conditions are available for use in scheduling fungicide applications.

Alternatives: IR-4 is scheduled to do residue trials on dimethomorph (Acrobat) in onions in 1999. Dimethomorph may be effective on downy mildew.

Bacterial Soft Rot, Slippery Skin and Sour Skin (*Erwinia* and *Pseudomonas* spp.)

Frequency of Occurrence: Annually, in all but the driest growing seasons.

Damage Caused: Bulbs and leaves infected with these bacterial diseases develop a characteristic slimy, watery softening of the bulb tissue and a foul odor. The core of bulbs infected with the bacteria can sometimes be squeezed out under pressure. Soft rots can spread in storage. The decay symptoms caused by these bacteria frequently overlap and are difficult to categorize.

% Acres Affected: 100% at risk; up to 75% affected.

Pest Life Cycles: The bacteria causing bacterial rots of onions survive in soil and crop debris. They may infect onions in the field, but infection is often only apparent in storage. There is increasing evidence that these bacteria may also be seedborne. Bacteria enter the onion via the bulb neck, possibly as leaves senesce in the field, but mostly via injuries such as those caused by mechanical topping, equipment, herbicides, hail or rain. They often occur in conjunction with other diseases, such as Botrytis neck rot, mostly as secondary invading organisms. Bacterial rots are especially common after heavy rains, hail, or even heavy overhead irrigation once bulbing has begun. *Pseudomonas alliicola* and *P. cepacia* are onion-specific. Others, such as *Erwinia* spp., have a wider host range.

Timing of Control: throughout growing season.

Yield Losses: can be up to 75% in severely affected fields.

Cultural Control Practices: The following cultural practices can help in disease management: minimizing injury throughout the growing season; avoiding highly susceptible varieties; curing onions well before storing.

Regional Differences: None.

Biological Control Practices: None.

Post-Harvest Control Practices: None.

Chemical Controls: No pesticides are currently available or effective on bacterial rots.

Other Issues: These diseases seem to be increasing in occurrence and severity. The NY onion industry has a strong need for effective control measures to manage losses to bacterial diseases.

Fusarium Basal Rot (*Fusarium oxysporum* f. sp. *cepae*)

Frequency of Occurrence: Can be found at least at low levels almost every year.

Damage Caused: The leaves of affected plants die back rapidly from the tip as plants approach maturity. Affected roots are dark brown, transparent, and hollow. Most of the roots eventually rot off, and in their place a mass of white moldy growth is produced. The bulbs become soft, and when cut, a semi-watery decay is found advancing from the base of the scales upward. The rot progresses slowly and early infections are often unnoticed at harvest time. Thus, the disease becomes a factor in transit and in storage, where the decay may continue until the bulbs are entirely destroyed. Frequently a secondary wet rot will invade the infected plants.

% Acres Affected: 100% at risk; up to 25% affected.

Pest Life Cycles: Fusarium basal rot is most severe in warm weather with high soil temperatures. The fungus is persistent and soilborne, overwintering in soil or on crop debris as thick-walled, resting spores called chlamydospores. Plants are infected primarily through wounds or as a result of infection by other pathogens. Intact tissues may also be invaded. Root maggot injuries are thought to be major entry sites for the fungus. The fungus is spread in water and soil and by insects and farm implements. Decay progresses slowly and often doesn't become noticeable until bulbs are in storage.

Timing of Control: Symptoms appear in the later stages of the growing season and in storage.

Yield Losses: Up to 50% in severely affected fields.

Cultural Control Practices: The following cultural controls can help manage this disease: planting resistant varieties; rotation away from onions for a minimum of three years (usually impractical); and avoiding mechanical damage during the growing season.

Regional Differences: None.

Biological Control Practices: None.

Post-Harvest Control Practices: Keeping onion storage areas dry and well-ventilated will help contain damage in storage.

Chemical Controls: No pesticides are available to manage this disease.

Pink Root (*Pyrenochaeta terrestris*)

Frequency of Occurrence: Annually.

Damage Caused: is caused by a fungus that is common to many soils and affects the roots of many different plants. The disease is confined to the roots of onion, yet it reduces bulb size. Onions can be infected during any stage of growth, yet the disease does not appear nearly so often in seedlings as in the mature crop. Pink root generally attacks weakened roots of mature plants. However, seedlings can also be infected. The fungus can survive in the soil for several years in the absence of host plants. Diseased plants can easily be pulled out of the soil, revealing a substantially reduced root system. Affected roots turn pink, shrivel and die. Eventually new roots become diseased and suffer loss of function. Damage is most severe during dry weather. The disease continues throughout the growing season, rarely killing the infected plants, however bulb size is reduced. During severe infections, onion tops turn white, yellow or brown and finally die. Plants infected early in the season do not bulb properly, while the later infected plants have stunted or softened bulbs. The disease becomes more apparent at harvest time when the size of the bulb is often inversely proportional to the severity of the attack.

% Acres Affected: 100%

Pest Life Cycles: The fungus that causes pink root overwinters in the soil. Symptoms first appear 7-21 days after infection. As the fungus grows within the plant, it moves through the cortex of the roots. Fruiting bodies called pycnidia are produced in dead tissue. Conidia produced in pycnidia can lead to further infection of other plants.

Timing of Control: Pre-plant, and throughout the season.

Yield Losses: Up to 50% in severely affected fields.

Cultural Control Practices: The following cultural practices can help in disease management: planting tolerant varieties; rotating away from onions and corn for 1-2 years; planting disease-free transplants; managing irrigation, drainage, and fertilization in infested fields to minimize plant stress.

Regional Differences: None.

Biological Control Practices: None.

Chemical Controls: No pesticides are registered to manage pink root.

Botrytis Neck Rot (*Botrytis allii*)

Frequency of Occurrence: Annually.

Damage Caused: Botrytis neck rot, caused by the fungus *Botrytis allii*, is a destructive and widespread storage disease. The initial infection originates in the field but symptoms generally do not appear until harvest and storage. Infection typically occurs when the weather is cool and moist during harvest and onions do not dry properly. Growers can decrease their losses by harvesting in dry weather when onions are at full maturity, and storing harvested onions under optimum conditions. The condition of the neck tissue at the time of harvest is important in determining the amount of infection. The more succulent the tissue, the greater the likelihood of infection. If bulbs mature well during dry weather before harvest, the chances of infection are greatly reduced.

% Acres Affected: 100%

Pest Life Cycles: The fungus survives in the soil and on crop residues. In moist weather, spores are disseminated by wind and splashing water. Cull piles near onion fields provide a source of inoculum, as does infested seed. There is often little or no evidence of Botrytis neck rot up to or at the time of harvest. The disease becomes obvious after onions are topped and have been stored for a few days. Scales begin to soften around the neck progressing toward the base. Infected tissue takes on a brownish, sunken, water-soaked appearance. A definite margin appears between healthy and diseased tissue. Infected tissue may be watery initially, but soon dries out. Under humid conditions, a gray mold often grows between the scales. This mold can often be seen only after removal of one or two outer scales. Small, black fruiting bodies called sclerotia can be seen encrusted on shriveled tissues. Several months often elapse before the entire bulb is destroyed.

Timing of Control: season-long.

Yield Losses: Up to 50% in severely affected fields.

Cultural and Post-harvest Control Practices: A number of cultural practices help in disease management, including the following: avoiding excessive and late-season applications of nitrogen fertilizer; undercutting and windrowing onions before topping and storing; leaving several inches of neck on the bulb; proper curing before storage; harvesting only when bulbs are fully mature; and managing storages for proper temperature and relative humidity. No resistant varieties are available.

Regional Differences: None.

Biological Control Practices: None.

Chemical Controls: Chlorothalonil, iprodione, maneb, mancozeb, and vinclozolin are all labeled and recommended for control of Botrytis neck rot. See "Botrytis Leaf Blight" section for pesticide use patterns.

Nematodes (Various spp.)

Frequency of Occurrence: Variable among fields within a region and between production areas, but increasing in frequency and severity.

Damage Caused: Nematodes feed on plant roots or injure the bulb. Yields may be reduced and plant growth slowed. Maturity may be delayed, causing storage and other disease problems. Damage is especially apparent during dry periods when injured plants wilt prematurely. Damage can be severe but patchy.

% Acres Affected: 100% at risk; up to 75% of acres affected.

Pest Life Cycles: A number of nematode species are pathogenic to onions and have been observed in NY including the root knot nematode (*Meloidogyne* spp.), onion bloat nematode (*Ditylenchus dipsaci*), root lesion nematode (*Pratylenchus penetrans*), and stubby root nematode (*Paratrichodorus* spp.). The root knot and lesion nematodes are most important at present. Root knot nematodes feed on and/or in roots of a wide range of plants. Nematodes can overwinter in a dormant state in the soil and maintain populations on susceptible crops and weeds. They cannot travel through the soil to any extent, but are rapidly spread by running water and contaminated equipment, transplants, sets, and bulbs. The mature female of root knot nematodes is immobile (attached to the root) but it continues to enlarge in size and eventually its posterior end becomes visible outside of the roots. Mature females lay eggs outside their body in a gelatinous sac. The onion bloat nematode also has a wide host range. It can overwinter in a dormant state in soil, crop debris, cull piles, and stored bulbs, and can survive for several years, even if seasons are dry and unsuitable for nematode development. They are spread in a similar manner to root knot nematodes. Onion bloat nematodes grow and develop in the leaf, neck, and bulb tissues. They grow to maturity within three to four weeks and several generations may occur each season.

Timing of Control: Pre-plant.

Yield Losses: Can be up to 50% in severely affected fields.

Cultural Control Practices: Rotation with nonhost crops (principally grain crops) for two years; use of antagonistic crops such as sudangrass and rapeseed; and avoiding the introduction of nematodes to clean fields on infected bulbs or infested soil on equipment can aid in disease management.

Regional Differences: The problem seems to be greater in certain growing areas (Central NY and Orange County).

Biological Control Practices: None.

Chemical Controls: The application of pre-plant soil fumigants is effective in controlling these nematodes. Only Telone-C and Vapam are registered for use in NY, but are not used widely because of the high cost of fumigation. Research results have shown that oxamyl (Vydate) is effective in controlling the root-knot nematode on onions grown on muck soils in NY (Abawi). A Special Local Need (24c) Labelling request for Vydate use on onion in NY was recently granted. Vydate is currently registered for use on onions in six other states, including on muck soils in Michigan.

Black Mold (*Aspergillus niger*)

Frequency of Occurrence: Sporadic but potentially serious.

Damage Caused: This fungus causes damage in stored onions, rendering bulbs unmarketable.

% Acres Affected: Occasionally storage losses can run very high, but typical losses are 1-2%.

Pest Life Cycles: Little is known about this sporadic but potentially serious storage disease of onions. Previous studies elsewhere has indicated that the pathogen can be seedborne, soilborne, or airborne. Seed lots in New York have tested positive for the presence of the pathogen. *A. niger* is favored by high temperatures and relative humidity. In several experiments, temperatures over 93°F have resulted in higher levels of black mold.

Timing of Control: Unknown.

Yield Losses: Up to 50% in severely affected storages.

Cultural and Post-harvest Control Practices: Unknown.

Regional Differences: Outbreaks are more common in warmer growing regions, i.e. Orange County.

Biological Control Practices: None.

Chemical Control Practices: No chemicals are labeled for control of black mold. Research is being conducted on efficacy and timing of fungicides currently registered for other onion diseases on black mold (Lorbeer).

Weeds

Broadleaf and Grass Weeds

Frequency of Occurrence: Annually.

Damage Caused: Onions are very sensitive to competition from weeds for many reasons and hence, weed control is crucial in onion production. Because of their slow growth, small stature, shallow roots, and thin canopy, onion seedlings are poor competitors with weeds. When grown from seed, onions are very slow to emerge, which gives weed seedlings a chance to become established before the crop emerges. The presence of weeds during crop establishment can greatly reduce yields because the onion is a very shallow-rooted crop and cannot compete very well for water and nutrients. Weeds can also cause a problem in established onion fields because onion plants have a relatively short stature and an upright leaf habit that doesn't effectively shade out competing weeds. Weed pressure before bulb formation significantly reduces yields. Later in the season, weeds may shade the bulbs and keep onions from drying quickly. Weeds that germinate later in the season have less impact on yield but they can interfere with mechanical harvesting equipment. Unlike many other vegetable crops, onions require almost 100% weed control for commercial production.

% Acres Affected: 100%

Pest Life Cycles: Annual and some perennial broadleaf weeds are a major problem in onion fields in New York. Seeds can germinate throughout the summer if adequate moisture is present. In the absence of regular moisture, flushes of seed germination often coincide with rainfall events or irrigation. Pigweed (*Amaranthus* spp.) is a vigorous annual that produces a very large number of seeds that can survive in the soil for up to 40 years. Within the pigweed group, the most serious species is redroot pigweed (*Amaranthus retroflexus*). Fields with a history of redroot pigweed must have pre-emergence or early post-emergence herbicides to prevent outbreaks in the current season.

Another important annual broadleaf weed is common lambsquarters (*Chenopodium album*). Common lambsquarters is a very adaptable weed that sets thousands of seeds and, like pigweed, can remain in the soil for many years. Most seeds germinate early in the growing season and control should be targeted for this time. Dense stands can smother onion seedlings.

Prostrate spurge (*Euphorbia humistrata/maculata*) is another annual broadleaf that presents a large problem in onion fields. It has a low growth habit and can go unnoticed until seed set has occurred. Mature plants may smother onion plants and pose a harvest problem. Other annuals that are a problem in New York onion fields are common purslane (*Portulaca oleracea*), shepherd's purse (*Capsella bursa-pastoris*) and common ragweed (*Ambrosia artemisiifolia*).

Annual grasses (Gramineae family) are also serious pests in onion fields because of their vigorous growth and ability to produce copious amounts of seed. This group of weeds poses the greatest competition to onions. They are also very tolerant to moisture and temperature extremes once they are established. All annual grasses should be controlled before they set seed.

Yellow nutsedge (*Cyperus esculentus*) is an extremely serious onion weed pest on both muck and mineral soils. Yellow nutsedge is a perennial monocot with grass-like foliage, but it is not a true grass, and is not controlled with grass herbicides. Even light infestations can reduce onion growth and bulb size, and heavy infestations can force a producer to abandon entire fields. The plant reproduces by underground tubers called nutlets. The underground tubers can overwinter and survive soil temperatures of -20° F. The tubers sprout from May to late July and each sprouting tuber is capable of producing numerous plants.

Timing of Control: Preplant, preemergence, and postemergence.

Yield Losses: 100% if no herbicide or other controls used. Even when herbicides and other controls are used, losses can still run as high as 25%.

Regional Differences: None.

Cultural Control Practices: A number of cultural practices can aid in weed management. Rotation to fallow or crops other than onions is sometimes an option, and can be very effective. Onion seed and transplants should be checked for possible weed and weed seed contamination. Equipment and implements should be cleaned between fields to avoid spread of seeds and plant parts. Certain types of cultivation are appropriate for muck-grown onions, however use of small grain windbreaks makes early-season cultivation impractical. Handweeding to control weeds that have escaped herbicides and other control measures is practiced on most onion acreage even though it is extremely expensive. Winter cover crops can be used to suppress weed growth in the fall and early spring.

Regional Differences: Weed species spectra differ between the growing regions, but all areas are faced with serious weed infestations.

Biological Control Practices: None.

Post-Harvest Control Practices: Cultivation. Post-harvest application of herbicides to control perennial weeds.

Other Issues: Because weed control is of such importance in onion production, research on chemical and non-chemical weed control methods is ongoing, and includes screening of new herbicides for efficacy and crop tolerance (Ellerbrock).

Chemical Controls:

Pesticide	% Trt.	Type of Appl.	Typical Rates lbs ai/acre	Timing	# of Appl.	PHI days	REI hours
bromoxynil <i>(Buctril)</i>	80	ground (muck soil only)	0.25-0.375	pre-emerge	1	120	12
paraquat <i>(Gramoxone)</i>	<1	ground (mineral soil only)	0.625-0.94	pre-emerge	1	120	12
glyphosate <i>(Round-Up)</i>	1-5	ground	1-2	pre-emerge	1	120	4
DCPA¹ <i>(Dacthal)</i>	<1	ground	8-10	pre-emerge or postemerge	1	110	12
oxyfluorfen <i>(Goal)</i>	95	ground	.003-.04	postemerge	2-4	45	24
fluazifop-p-butyl <i>(Fusilade)</i>	95	ground	0.13	postemerge	1-3	45	12
sethoxydim <i>(Poast)</i>	5	ground	0.19-0.28	postemerge	1	45	12
clethodim <i>(Select)</i>	1-5	ground	0.1-0.24	postemerge	1	45	12

metolachlor² <i>(Dual, Dual Magnum)</i>	20-30	ground	1-2	postemergence	1-3	45	24
pendimethalin <i>(Prowl)</i>	95	ground	1-2	at emergence, postemergence	2	45	12

1. For use on mineral soils only.

2. Available in NY under a Third Party label, held by the NYS Vegetable Growers Association.

Use in IPM Programs: Use is consistent with Cornell IPM recommendations. A 2(ee) recommendation has been established for multiple applications of oxyfluorfen at lower rates.

Use in Resistance Management: None reported.

Efficacy Issues: The listed herbicides have different but overlapping spectra of species control. Bromoxynil is effective on broadleaves, but not grasses. DCPA, oxyfluorfen, metolachlor, pendimethalin, glyphosate and paraquat control broadleaves and grasses. Sethoxydim, clethodim, and fluzifop p-butyl are effective on annual grasses and on small-grain windbreaks. Clethodim is the only herbicide which controls annual bluegrass. Metolachlor suppresses, but does not completely control, yellow nutsedge, and controls hairy galinsoga. The loss of pendimethalin, metolachlor, oxyfluorfen, bromoxynil, or fluzifop p-butyl would seriously compromise weed control. In addition, the industry has an urgent need for a more effective material for control of yellow nutsedge.

Alternatives: Dimethenamid (Frontier) would be a very effective herbicide for yellow nutsedge control. Residue trials have already been run by IR-4, and the company (BASF) is in the process of applying for full registration. In the event that dimethenamid did not receive a label, bentazon (Basagran) could be a very useful tool in managing yellow nutsedge. Clopyralid (Stinger) has excellent activity on Canada thistle, ragweed and pineapple weed, species that are not adequately controlled by currently registered herbicides.

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9. Information for and review of this Crop Profile were provided by members of the New York State Onion Industry Council, an advisory committee comprised of producers, processors, consultants, researchers and Extension Educators. Many other individual producers provided input and review as well.