

# New England Winter Squash Crop Profile

Compiled for the New England Pest Management Network by:

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## **Production Facts**

**Regional ranking:** 8th

**Contribution to US total:** 3.24%

**Total acres grown:** 4,727

**Total acres harvested:**

**Cash value:**

**Production Costs/yearly:** \$1,493.42 (for Butternut Squash does not include land costs)

**% Fresh market<sup>1</sup>:** 83%

**% Processing<sup>1</sup>:** 14%

**Production regions within region:** (Based on NASS statistics)

Connecticut (1282 Acres), Maine (383 Acres), Massachusetts (2187 Acres),  
New Hampshire (402 Acres), Rhode Island (267 Acres), Vermont (206 Acres).

## **Cultural Practices**

Winter squash plants grow best in a well-drained sandy loam soil high in organic matter with a pH of 6.5-6.8. The most common varieties grown in New England include Butternut (54%<sup>1</sup>), Buttercup (19%<sup>1</sup>), Acorn (11%<sup>1</sup>) and Hubbard (5%<sup>1</sup>). Direct seed planting (72%<sup>1</sup> of growers) is done when soil temperature reaches an average of 60° F or higher. In New England, this is typically between mid-May and early June. Winter squash may be planted into bare ground or into a winter rye no-till growing system. Occasionally winter squash is planted into raised beds with plastic mulch using transplants or direct seed.

Transplants are used by 43%<sup>1</sup> of the growers are to create an earlier, more uniform, and more vigorous crop. Transplants are seeded in greenhouses around mid-April, or at least three weeks prior to planting, and are planted in the field when they reach the 3-4 leaf stage. Transplants can be hardened by placing them outside in a protected area before they are planted in the field. Transplants started in the greenhouse should be covered with row cover or hot caps if planted in the field before the frost-free date to avoid frost injury.

When direct seeding, squash seed should be planted  $\frac{3}{4}$  to 1-1/4 inches deep depending on the soil type. Enough seed should be sown to ensure adequate germination. Extra plants can be thinned later. Recommended seed rates are 2-4 pounds per acre for winter squash. Plant spacing for smaller bush squash varieties should be 18-24" within rows and 4-5 feet between rows. Vining varieties should be planted 2-6 feet apart within rows and 6-12 feet between rows. Proper plant spacing can ensure desired fruit size.

Bee pollination is very important for good fruit set in winter squash. One hive per acre is recommended for good pollination. Growers (32%) import bee hives to the fields. Pollination typically takes place over a three-week period. Inadequate pollination can result in poorly shaped fruit and excessive flower bud drop.

## **Worker Activities**

### **Fertilizing and soil preparation**

Fertilizer is banded at planting if soil test results indicate treatment is needed. A pre-plant broadcast application may be used if fertilizer application at planting is not practiced. Nitrogen can be side-dressed or applied through trickle or overhead irrigation. Foliar feeding rate of urea is 4-5 pounds per acre.

### **Irrigation & Plastic mulch**

Worker activities include application of plastic mulch and set up of irrigation systems when needed. Drip irrigation (practiced by 22% of the growers) may be laid under plastic mulch.

### **Thinning & Row Covers**

When seedlings are established workers will thin to 1 plant for every 2-6 feet within rows depending on winter squash variety. Workers (19%) place row covers for insect management above crop rows at the 3-4 leaf stage.

### Weeding

Hand weeding and hoeing are done as needed until runners are initiated that can shade out weed growth. Weed control can be expensive in winter squash production so early control is important to save on labor costs. Spot treatment of weeds can be done with a backpack sprayer using contact herbicides.

### Mowing

Mowing around field edges and in between interseeded rows discourages pests from establishing. Mowing is also done to remove host sites for pests that spread diseases.

### Field Scouting

Field scouting should be conducted weekly to monitor for pest outbreaks, fruit set and disease development. A scouting method should be developed which involves observing the entire field in a grid like pattern. Plant development and pest damage should be observed for each plant and recorded during each scout. A weed inventory should also take place weekly.

### Harvesting

Hand harvesting is done in late September and early October after the skin is completely hardened. Winter squash may be marketed immediately or placed in storage bins to cure before sale. In some varieties of winter squash such as butternut, removal of handles is desirable to minimize post harvest damage when packed.

## **Post Harvest Practices**

Well-matured fruit free of injury and disease are best for storage. Storage temperatures should be kept between 55° and 60° with a relative humidity of 50-75%. Chilling injury can occur at temperatures below 55°. Good air circulation is important in storage to reduce disease. Harvested fruit should be carefully inspected for signs of disease infection before being placed in storage bins as diseases from the field can infect and spread during storage. Sanitize and disinfect storage bins before use. Storage for Hubbard and Butternut squash can last up to six months. Acorn and Buttercup squash can be stored for 2 months or more when conditions are favorable. Squash should be stored away from other fruits and vegetables that are ethylene producers since ethylene can aid in fruit decay.

## Commodity Destination<sup>1</sup>

Fresh market retail: 37.1%  
U-Pick: 0.1%  
Fresh market, wholesale: 46.1%  
Processing: 13.7%  
Other: 0.5%

## Winter Squash Insect Pests

**ID:** Striped Cucumber Beetle (*Acalymma vittata*)

**Frequency:** annually

**Damage:** Feeding on roots and cotyledons done early in the season can kill small plants quickly. Striped cucumber beetles overwinter on the edges of fields, and then emerge when warm temperatures persist and begin feeding immediately on available plant material. The adult beetles are attracted to the fleshy cotyledons of young plants while the larvae will feed on roots. This feeding causes stunted plants and can slow plant development. Adults will also feed on plant foliage, stems, flowers and fruit.

The biggest threat posed by the striped cucumber beetle is its ability to vector diseases. The most economically destructive disease vectored by the beetle is bacterial wilt. Bacterial wilt is caused by the bacterium *Erwinia tracheiphila* that is transferred throughout cucurbit fields in the Northeast by the frass of the striped cucumber beetle. Once plants are infected with this xylem-limited bacterium, the vascular system becomes impaired causing severe plant wilt that will eventually lead to plant death. Necrotic spots will show up on foliage and spread until the leaf collapses. The symptoms of this disease are irreversible and can have devastating effects on yield. Crop losses have been recorded as 100% in severely infested areas.

**Percent Acres infested<sup>1</sup>:** 78.2%

**Control timing:** Cucumber beetle control should happen early in the season during the heavy feeding activity in early May throughout June. However, the beetle can also be a problem in mid-summer during flowering. Adult beetles will feed on blossoms greatly reducing yields. Applying a systemic insecticide at planting will control first generation adults. Scout plants from crop emergence to the true leaf stage to see if populations are greater than two beetles per plant. If more than 15% of the plants are showing 20% feeding damage control is

necessary. It is crucial to eradicate beetle populations early in the season to suppress the development and spread of bacterial wilt.

**Yield losses:** can be phenomenal

**Regional Differences:** none

## **Chemical Controls**

**Active Ingredient:** Carbaryl (Sevin XLR Plus)

**Formulations:** emulsifiable concentrate

**Percent crop treated<sup>1</sup>:** 48.2%

**Types of application:** Foliar spray

**Rates:** 1 qt/A

**Timing:** Best control is early in the season during the heavy feeding activity period. Apply during the season when damage thresholds have been reached. Thresholds are reached when an average of 2 or more beetles is found per plant, or when 15% of the plants have 20% or more damage.

**# applications/season:** < 6 qt/A per season

**Pre-harvest interval:** 3 days

**REI:** 12 hrs

**Use of chem. in IPM program:** Monitor plants weekly to see pest population numbers and apply when the damage threshold is reached. This chemical is extremely toxic to bees; apply at dawn or dusk when bee activity is low.

**Use in resistance program:** Resistance management strategies should be established for the specific use area. If resistance occurs, use another chemical control with a different mode of action.

**Efficacy:** Excellent/Good

**Active Ingredient:** Esfenvalerate (Asana XL)

**Formulations:** emulsifiable concentrate

**Percent crop treated<sup>1</sup>:** 6.3%

**Types of application:** foliar spray

**Rates:** 5.8-9.6 oz /A

**Timing:** Best control is early in the season during the heavy feeding activity period. Apply during the season when damage thresholds have been reached. Thresholds are reached when an average of 2 or more beetles are found per plant, or when 15% of the plants have 20% or more damage.

**# applications/season:** <. 25lbs active ingredient/A per season

**Preharvest interval:** 3 days

**REI:** 12 hrs

**Use of chem. in IPM program:** Treatment should be made after thresholds discussed above have been reached.

**Use in resistance program:** Resistance management strategies should be established for the specific use area. If resistance occurs, use another chemical control with a different mode of action.

**Efficacy:** Excellent/Good

**Active Ingredient:** Imidacloprid (Admire 2F)

**Formulation:** flowable

**Percent crop treated<sup>1</sup>:** 5.3%

**Type of application:** In-furrow or seed drench

**Rates:** 1-1.5 pt/A

**Timing:** at planting

**# applications /season:** 1

**REI:** 12 hrs

**Pre-harvest interval:** 21 days

**Use in IPM:** One initial application provides adequate control all season, reducing ground water contamination and effects on non-targets.

**Use in resistance management:** Do not use with Provado. Use in accordance with resistant management strategies established for the given use area.

**Efficacy:** Excellent

**Active Ingredient:** Kaolin (Surround WP)

**Formulations:** wettable powder

**Percent crop treated<sup>1</sup>:** 1.6%

**Types of application:** foliar spray

**Rates:** 6.25-25 lb/A

**Timing:** used as a preventative control, apply at seed emergence to harvest.

**# applications/season:** as many as needed

**Pre-harvest interval:** 0 days for produce that is not sprayed itself, 30 days for produce that is not washed or cannot be washed easily. Product may need to be washed off if applied after fruit set.

**REI:** 4 hrs

**Use of chem. in IPM program:** When used correctly as a preventative control, no further control is needed.

**Use in resistance program:** Resistance management strategies should be established for the specific use area. If resistance occurs, use another chemical control with a different mode of action.

**Efficacy:** Good

**Active Ingredient:** Permethrin (Ambush)

**Formulations:** emulsifiable concentrate

**Percent crop treated<sup>1</sup>:** 16.3%

**Types of application:** foliar spray

**Rates:** 6.4-12.8 oz /A

**Timing:** Best control is early in the season during the heavy feeding activity period. Apply during the season when damage thresholds have been reached. Thresholds are reached when an average of 2 or more beetles are found per plant, or when 15% of the plants have 20% or more damage.

**# applications/season:** < 1.6 lb /A per season.

**Pre-harvest interval:** 0 days

**REI:** 12 hrs

**Use of chem. in IPM program:** Apply when damage thresholds discussed above have been reached.

**Use in resistance program:** Resistance management strategies should be established for the specific use area. If resistance occurs, use another chemical control with a different mode of action.

**Efficacy:** Excellent/Good

**Alternatives:** Sticky traps in fields can trap beetles reducing infestation. Row cover can be used prior to pollination to protect plants from early feeding damage. Planting a more susceptible border (commonly referred to as a perimeter trap crop) around winter squash plantings can discourage feeding on the main crop. Deep tillage in the fall may kill off some over wintering adults before they move to field edges. Crop rotation away from cucurbits between years is also highly recommended.

**Cultural control practices for pest management:**

**Planting dates:** Later plantings may miss the heavy feeding activity period for striped cucumber beetles reducing feeding damage and disease transmission.

**Resistant/Less desirable varieties:** Butternut squash may be less attractive to the beetle.

**Row spacing:** none

**Biological Control:** Release of biological controls such as tachinid flies, parasitoid wasps and predacious nematodes has been shown to result in high parasitism rates.

**Post Harvest Control Practices:** none

**ID: Squash Bug (*Anasa tristis*)**

**Frequency:** annually

**Damage:** Seedlings can be fed on and damaged by overwintering adults. Adults will lay copper colored eggs on the upper and lower surfaces of plant leaves. Once these eggs hatch the nymphs will cluster together and begin feeding. Feeding causes damage to the leaves, flowers, and vines leaving a scorched look to foliage. Feeding can also damage fruit when populations are high enough. Treatment may be necessary if feeding damage is observed. Squash bug feeding can vector viral diseases that cause vine decline and can eventually take entire plants down. Populations are usually higher in no-till and organic growing systems that are high in organic matter.

**Percent Acres infested<sup>1</sup>:** 25.2%

**Control timing:** Best control is gained when squash bugs are in the nymph life stage or when runners develop; this is usually in mid and late July. Timing is important in controlling populations. Scout plants for eggs during flowering. Treat if more than one egg mass per plant is found to kill off emerging adults. Good coverage is essential to control.

**Yield losses:** minimal

**Regional Differences:** none

### **Chemical Controls**

**Active Ingredient:** Carbaryl (Sevin XLR Plus)

**Formulations:** Emulsifiable concentrate

**Percent crop treated<sup>1</sup>:** 13.8%

**Types of application:** Foliar spray

**Rates:** 1 qt/A

**Timing:** For best control spray when runners develop during nymph stages of life cycle usually during mid July.

**# applications/season:** < 6qt/A per season

**Pre-harvest interval:** 3 days

**REI:** 12 hrs

**Use of chem. in IPM program:** Best squash bug control is in the nymph stage during runner development. During flowering, spray after egg mass averages reach 1 or more per plant.

**Use in resistance program:** Resistance management strategies should be established for the specific use area. If resistance occurs, use another chemical control with a different mode of action.

**Efficacy:** Good

**Active Ingredient:** Esfenvalerate (Asana XL)

**Formulations:** Emulsifiable concentrate

**Percent crop treated<sup>1</sup>:** 2.4%

**Types of application:** foliar spray

**Rates:** 5.8-9.6 oz/A

**Timing:** For best control spray when runners develop during nymph stages of life cycle during mid July.

**# applications/season:** <. 25 lb active ingredient/A per season

**Pre-harvest interval:** 3 days

**REI:** 12 hrs

**Use of chem. in IPM program:** Best squash bug control is in the nymph stage during runner development if needed. During flowering, spray after egg mass averages reach 1 or more per plant.

**Use in resistance program:** Resistance management strategies should be established for the specific use area. If resistance occurs, use another chemical control with a different mode of action.

**Efficacy:** Excellent/Good

**Active Ingredient:** Permethrin (Ambush)

**Formulations:** Emulsifiable concentrate

**Percent crop treated<sup>1</sup>:** 8.5%

**Types of application:** foliar spray

**Rates:** 5.8-9.6 oz/A (use of a high rate is recommended for squash bug control)

**Timing:** For best control spray when runners develop during nymph stages of life cycle during mid July.

**# applications/season:** < 1.6 lb/A per season

**Pre-harvest interval:** 0 days

**REI:** 12 hrs

**Use of chem. in IPM program** Best squash bug control is in the nymph stage during runner development if needed. During flowering, spray after egg mass averages reach 1 or more per plant.

**Use in resistance program:** Resistance management strategies should be established for the specific use area. If resistance occurs, use another chemical control with a different mode of action.

**Efficacy:** Excellent/Good

**Alternatives:** Early detection is the best way to control squash bug populations. Row covers should be placed before pollination to deter beetles from entering the growing system early in the season. Removal of plant and other debris from the field at the end of the season can reduce overwintering

sites. Deep tillage of the soil after harvest can often kill off some of the overwintering adults. Wooden boards may be placed around the field and used as traps. Large groups of squash bugs will congregate under these boards and can be placed in buckets of soapy water for extermination.

**Cultural control practices for pest management:**

**Planting dates:** none

**Resistant/Less desirable varieties:** Resistant varieties to squash bug include *Butternut*, *Royal Acorn*, *Swiss Cheese* and *Black Zucchini* winter squash.

**Row spacing:** none

**Biological Control:** The tachinid fly is a parasitoid of squash bug nymphs and can be released to control populations.

**Post Harvest Control Practices:** none

**ID: Squash Vine Borer (*Elasmopalpus lignosellus*)**

**Frequency:** sporadic

**Damage:** Adult squash vine borers lay their eggs on the vines of mature plants early in the season. Damage is not recognized until the eggs hatch and the larvae start feeding within the vines in July and August. The larval feeding causes plants to wilt dramatically. If feeding continues beyond this point, girdling of the vines will take place. This can lead to crown rot and secondary infections. Frass resulting from feeding at the base of plant stems is a sign of borer infestation. The older frass will become moist and shiny and will start oozing from wounds made from earlier feeding. Internal stem tissue will become exposed and detach from the rest of the plant at the soil level. Adults will emerge from infested plant stems around harvest time and overwinter in the soil inside cocoons, only to emerge again in the spring to reinfest plant tissue.

**Percent Acres infested<sup>1</sup>:** 21.9%

**Control timing:** The best way to control the squash vine borer is to spray the larvae before they enter the stem from mid June to August. Make three or four applications at one-week intervals beginning the first week of July or when larvae is seen at the base of plants. Once the larvae enter the stems insecticides are useless control measures. Plant stems should be scouted early in the season for borer feeding damage and treated when seen.

**Yield losses:** Can be phenomenal.

**Regional Differences:** none

## Chemical Control

**Active Ingredient:** Carbaryl (Sevin XLR Plus)

**Formulations:** Emulsifiable concentrate

**Percent crop treated<sup>1</sup>:** 10.9 %

**Types of application:** foliar spray

**Rates:** 1qt/A

**Timing:** The best way to control the squash vine borer is to spray the larvae with insecticides before they enter the stem from mid June to August or when frass is seen around plant stems.

**# applications/season:** < 6qt/A per season

**Pre-harvest interval:** 3 days

**REI:** 12 hrs

**Use of chem. in IPM program:** Fields should be scouted beginning in mid June and stems should be opened when frass is seen to see if larvae are present. This material is very toxic to bees; apply when bee activity is minimal.

**Use in resistance program:** Resistance management strategies should be established for the specific use area. If resistance occurs, use another chemical control with a different mode of action.

**Efficacy:** Excellent/Good

**Active Ingredient:** Esfenvalerate (Asana XL)

**Formulations:** Emulsifiable concentrate

**Percent crop treated<sup>1</sup>:** 2.8%

**Types of application:** foliar spray

**Rates:** 5.8-9.6 oz/A

**Timing:** The best way to control the squash vine borer is to spray the larvae with insecticides before they enter the stem from mid June to August or when frass is seen around plant stems.

**# applications/season:** <. 25 lb active ingredient per season

**Pre-harvest interval:** 3 days

**REI:** 12 hrs

**Use of chem. in IPM program:** Fields should be scouted beginning in mid June and stems should be opened when frass is seen to see if larvae are infecting stems. This material is very toxic to bees; apply when bee activity is minimal.

**Use in resistance program:** Resistance management strategies should be established for the specific use area. If resistance occurs, use another chemical control with a different mode of action.

**Efficacy:** Excellent/Good

**Active Ingredient:** Permethrin (Ambush)

**Formulations:** Emulsifiable concentrate

**Percent crop treated<sup>1</sup>:** 6.6 %

**Types of application:** foliar spray

**Rates:** 5.8-9.6 oz/A

**Timing:** The best way to control the squash vine borer is to spray the larvae with insecticides before they enter the stem from mid June to August or when frass is seen around plant stems.

**# applications/season:** < 1.6 lb/A per season

**Pre-harvest interval:** 0 days

**REI:** 12 hrs

**Use of chem. in IPM program:** **Fields** should be scouted beginning in mid June and stems should be opened when frass is seen to see if larvae are infecting stems. This material is very toxic to bees; apply when bee activity is minimal.

**Use in resistance program:** Resistance management strategies should be established for the specific use area. If resistance occurs, use another chemical control with a different mode of action.

**Efficacy:** Excellent/Good

**Alternatives:** Row covers can be used to discourage adults from laying eggs on plant stems early in the season. Avoid repeat infections the following year by destroying crop debris, rotating planting fields away from cucurbits and deep tillage to kill off overwintering cocoons.

### **Cultural control practices for pest management:**

**Planting dates:** plant under dry conditions in shallow depths to speed up germination.

**Resistant/Less desirable varieties:** none.

**Row spacing:** none

**Biological Control:** none

**ID:** Aphids (mainly *aphis gossypi*)

**Frequency:** sporadic

**Damage:** Direct feeding by aphids can be a problem if populations on average are greater than 5 or more aphids per leaf. Adults will congregate on the undersides of leaves and feed on plant sap causing stunted growth, distorted leaves and viral infections. Feeding damage can be noticeable but the major problem associated with aphids is their ability to vector viral infections. The main viruses vectored by aphids are the cucumber mosaic virus, watermelon mosaic virus, papaya ring spot virus and the zucchini yellow mosaic virus.

These viruses cause yellow distorted leaves, stunted growth and decreased yield. Late plantings are more susceptible to aphid feeding and viral infection. During periods of extreme heat and drought aphid populations can multiply rapidly. By-products of aphid feeding can attract secondary infections such as sooty mold to leaf surfaces and fruit.

**Percent Acres infested<sup>1</sup>:** 18.5%

**Control timing:** Typically in early July or when runners are sent. Monitor 50 older leaves at 10 different sites within the field and do not treat until 20% (10 out of 50) of the leaves have 5 or more aphids per leaf.

**Yield losses:** minimal

### **Chemical controls**

**Active Ingredient:** Insecticidal soap (M-Pede)

**Formulation:** liquid concentrate

**Percent crop treated<sup>1</sup>:** .7%

**Type of application:** foliar spray

**Rates:** 1.25-2.5 oz/gal water

**Timing:** Treat when runners are sent in early July up to harvest due to the pre-harvest interval of 0 days.

**# applications/season:** 1-3

**REI:** 12 hrs

**Pre-harvest interval:** 0 days

**Use in IPM:** Monitor 50 older leaves at 10 different sites within the field and do not treat until 20% (10 out of 50) of the leaves have 5 or more aphids per leaf.

**Use in resistance management:** Resistance management strategies should be established for the specific use area. If resistance occurs, use another chemical control with a different mode of action.

**Efficacy:** Fair

**Active Ingredient:** Methomyl (Lannate LV)

**Formulation:** water soluble liquid

**Percent crop treated<sup>1</sup>:** 8.6 %

**Type of application:** foliar spray

**Rates:** 1.5-3 pt/A

**Timing:** Typically when runners are sent in early July. If using a higher rate do not apply within 3 days of harvest.

**# applications/season:** 1-3

**REI:** 48 hrs

**Pre-harvest interval:** 1-3 days depending on rate (1 day for 1-1/2 pt, 3 days for over 1-1/2 pt)

**Use in IPM: Monitor** 50 older leaves at 10 different sites within the field and do not treat until 20% (10 out of 50) of the leaves have 5 or more aphids per leaf.

**Use in resistance management:** Resistance management strategies should be established for the specific use area. If resistance occurs, use another chemical control with a different mode of action.

**Efficacy:** Excellent/Good

**Active Ingredient:** Oxydemeton-methyl (Metasystox-R SC)

**Formulation:** soluble concentrate

**Percent crop treated<sup>1</sup>:** 0%

**Type of application:** foliar spray

**Rates:** 1.5-2 oz/A

**Timing:** Typically when runners are sent in early July. This product should be used during the beginning of the season due to the long pre-harvest interval.

**# applications/season:** 1

**REI:** 48 hrs

**Pre-harvest interval:** 14 days

**Use in IPM:** Monitor 50 older leaves at 10 different sites within the field and do not treat until 20% (10 out of 50) of the leaves have 5 or more aphids per leaf.

**Use in resistance management:** Resistance management strategies should be established for the specific use area. If resistance occurs, use another chemical control with a different mode of action.

**Efficacy:** Excellent

**Active Ingredient:** Permethrin (Ambush)

**Formulations:** Emulsifiable concentrate

**Percent crop treated<sup>1</sup>:** 6.2%

**Types of application:** foliar spray

**Rates:** 5.8-9.6 oz/A

**Timing:** When runners are sent in early July and up to harvest due to the 0 day pre-harvest interval.

**# applications/season:** < 1.6-lbs/A active ingredient per season

**Pre-harvest interval:** 0 days

**REI:** 12 hrs

**Use of chem. in IPM program:** Monitor 50 older leaves at 10 different sites within the field and do not treat until 20% (10 out of 50) of the leaves have 5 or more aphids per leaf.

**Use in resistance program:** Resistance management strategies should be established for the specific use area. If resistance occurs, use another chemical control with a different mode of action.

**Efficacy:** Fair/ Poor

**Active Ingredient:** Pymetrozine (Fulfill)

**Formulation:** water-dispersible granules

**Percent crop treated<sup>1</sup>:** 2.8%

**Type of application:** foliar spray

**Rates:** 2.75oz/A

**Timing:** Typically when runners are sent in early July. This product should be used early in the season due to the long pre-harvest interval.

**# applications/season:** < 5.5 oz/A per season

**Pre-harvest interval:** 14 days

**REI:** 12 hours

**Use in IPM:** Monitor 50 older leaves at 10 different sites within the field and do not treat until 20% (10 out of 50) of the leaves have 5 or more aphids per leaf.

**Use in resistance management:** Resistance management strategies should be established for the specific use area. If resistance occurs, use another chemical control with a different mode of action.

**Efficacy:** Unknown

**Alternatives:** Remove weeds in and around greenhouses and around fields that can serve as host sites for aphids. Keep transplants away from other plants such as peppers and tomatoes that are susceptible to aphid feeding and to the same viral strains as winter squash. Reflective mulch and row covers can protect plants from aphid infestation if used before populations are established.

**Cultural control practices for pest management:**

**Planting dates:** none

**Resistant/Less desirable varieties:** none

**Row spacing:** none

**Biological Control:** Natural predators including lacewings, syrphid flies, ladybird beetles and other parasitoids. These natural predators can be released into a growing system or can be naturally occurring (something to take into consideration before spraying).

**ID: Seedcorn maggot (*Delia platura*)**

**Frequency:** sporadic

**Damage:** Female flies lay their eggs in fields high in organic matter or manure in the early spring. Once the eggs hatch the larvae will infect fields by burrowing into sprouting seeds and destroying them. Feeding reduces germination rates and can kill emerging plants. Seed is more vulnerable to infestation the longer it remains in the soil.

Cool wet conditions will reduced germination time and therefore increase the occurrence of the seedcorn maggot.

**Percent Acres infested<sup>1</sup>:** 3.1%

**Control timing:** Cultural control practices should take place in the beginning of the season prior to crop emergence. Currently there are no insecticides registered for use against seedcorn maggot.

**Yield losses:** minimal

**Regional Differences:** none

**Chemical Controls:** There are currently no pesticides registered for control of the seedcorn maggot.

**Alternatives:** Plant transplants instead of direct seeding squash if a known problem exists. Use insecticide treated seed if direct seeding. Avoid spreading of organic matter before planting to make the field less desirable for adult flies to lay eggs in.

**Cultural control practices for pest management:**

**Planting dates:** Plant mid-June to avoid the first generation of eggs. Also avoid planting during periods of low temperatures and heavy rainfall when seed germination is delayed.

**Resistant/Less desirable varieties:** none

**Row spacing:** none

**Biological Control:** none

**Post Harvest Control Practices:** none

## Winter Squash Diseases

**ID:** Powdery Mildew (*Sphaerotheca fuliginea*)

**Frequency:** annually

**Damage:** This fungus shows up as white circular spots on the undersides of older or shaded leaves and then spreads rapidly within fields to leaf petioles and stems. Infected leaves will turn yellow, brown and then die off. The fungus can be a major problem once infection is noticed and is extremely difficult to eradicate. Powdery mildew also predisposes plants to secondary infections. Premature plant death can result from a severe infection.

**Percent Acres infested**<sup>1</sup>: 51.2 %

**Control timing:** Usually after fruit initiation at the end of July and early August until two weeks before harvest when disease development conditions are favorable. Powdery mildew should be treated at the first sign of disease.

**Yield losses:** can be phenomenal

**Regional Differences:** none, the disease may occur more in areas with high relative humidity and low temperatures.

### Chemical Controls

**Active Ingredient:** Azoxystrobin (Quadris)

**Formulation:** flowable concentrate

**Percent crop treated**<sup>1</sup>: 30.7 %

**Type of application:** foliar spray

**Rates:** 11-15.4 fl oz/A

**Timing:** after fruit initiation in July and August, apply at first sign of disease, or when disease development conditions are favorable.

**# applications/season:** < 4 per season. Do not apply more than once without rotating with another chemical with a different mode of action.

**REI:** 4 hrs

**Pre-harvest interval:** 1 day

**Use in IPM:** Quadris should be used in an IPM program that involves using resistant varieties, proper fertilization, crop rotation and accurate timing of application for best control.

**Use in resistance management:** Do not apply more than once without rotating with a fungicide that has a different mode of action to avoid resistance.

**Efficacy:** Excellent/Good

**Active Ingredient:** Chlorothalonil (Bravo Ultrex 82 WDG)

**Formulation:** water dispersible granules

**Percent crop treated**<sup>1</sup>: 22.3 %

**Type of application:** foliar spray

**Rates:** 2 lb/A

**Timing:** after fruit initiation in July and August, apply at first sign of disease, or when disease development conditions are favorable.

Coverage is essential because this is a contact fungicide.

**# applications/season:** < 19.1 lbs/A per season

**REI:** 24 hrs

**Pre-harvest interval:** 1 day

**Use in IPM:** Scout fields in a grid like pattern at the onset of fruit initiation and spray at the first sign of disease.

**Use in resistance management:** Bravo Ultrex but is a contact fungicide so coverage is essential. Rotate use with a fungicide with a different mode of action.

**Efficacy:** Good/ Fair

**Active Ingredient:** Cupric Hydroxide (Kocide 4.5 LF)

**Formulation:** liquid flowable

**Percent crop treated**<sup>1</sup>: 12.7%

**Type of application:** foliar

**Rates:** 1.3 pt/A

**Timing:** after fruit initiation in July and August, apply at first sign of disease on a 5-7 day intervals.

**# applications/season:** as often as needed

**REI:** 24 hrs

**Pre-harvest interval:** 0 days

**Use in IPM:** Scout fields in a grid like pattern at the onset of fruit initiation and spray at the first sign of disease.

**Use in resistance management:** Resistance management strategies should be established for the specific use area. If resistance occurs, use another chemical control with a different mode of action.

**Efficacy:** Good

**Active Ingredient:** Myclobutanil (Nova 40W)

**Formulation:** wettable powder

**Percent crop treated**<sup>1</sup>: 6.2 %

**Type of application:** foliar spray

**Rates:** 2.5-5 oz/A

**Timing:** after fruit initiation in July and August, apply at first sign of disease, or when disease development conditions are favorable. Always rotate with a fungicide with a different mode of action.

**# applications/season:** < 1.5 lbs/A per season

**REI:** 24 hrs

**Pre-harvest interval:** 0 days

**Use in IPM:** Scout fields in a grid like pattern at the onset of fruit initiation and spray at the first sign of disease.

**Use in resistance management:** Resistance management strategies should be established for the specific use area. If resistance occurs, use another chemical control with a different mode of action.

**Efficacy:** Good

**Active Ingredient:** Thiophanate methyl (Topsin M 70W)

**Formulation:** wettable powder

**Percent crop treated<sup>1</sup>:** 13.6 %

**Type of application:** foliar spray

**Rates:** 4-8 oz/A

**Timing:** after fruit initiation in July and August, apply at first sign of disease, or when disease development conditions are favorable. Apply only once per season, do not use in the same season with Benlate.

**# applications/season:** 1

**REI:** 12 hrs

**Pre-harvest interval:** 0 days

**Use in IPM:** Scout fields in a grid like pattern at the onset of fruit initiation and spray at the first sign of disease.

**Use in resistance management:** do not use with Benlate in the same season. Rotate between different chemical families and modes of action to avoid resistance.

**Efficacy:** Good

**Alternatives:** Use fungicides as preventative measures against disease, instead of a cure. Use of fungicide treated seed and pasteurized media if planting transplants is recommended. Destroy infected plant material and remove potential sources of inoculums. Keep plants healthy, weak plants are more susceptible to infection. Do not over water plants. Practice crop rotation in fields where problems have been in past years.

**Cultural control practices for disease management:**

**Planting dates:** none

**Resistant/Less desirable varieties:** It is suspected that powdery mildew resistant varieties are more susceptible to bacterial wilt.

**Row spacing:** none  
**Biological Control:** none  
**Post Harvest Control:** none

**ID:** Downy Mildew (*Pseudoperonospora cubensis*)

**Frequency:** sporadic

**Damage:** Downy mildew usually does not occur in the Northeast until the end of the season because the spores do not overwinter in this region but instead move to the northeast on wind currents from the south. The disease is more likely to show up in seasons with extensive rainfall and cooler temperatures. Once spores land on cucurbit plants, symptoms generally begin as chlorotic spots on leaf surfaces. Eventually the sporangia will grow on the undersides of leaves appearing as fuzzy purplish gray growth. The growth can lead to defoliation of the leaves reducing photosynthesis and yield.

**Percent Acres infested**<sup>1</sup>: 21.5%

**Control timing:** Mid July till the end of harvest when disease development conditions exist.

**Regional Differences:** Disease pressure may be worse on the coast where wind currents carry spores first.

### Chemical Control

**Active Ingredient:** Fosetyl AL (Aliette WDG)

**Formulation:** water dispersible granules

**Percent crop treated**<sup>1</sup>: 0%

**Type of application:** foliar spray

**Rates:** 3-5 lb/A

**Timing:** Mid July until the end of harvest. Spray at first sign of disease on 7-14 days intervals

**# applications/season:** 1-7

**REI:** 12 hrs

**Pre-harvest interval:** 0 days

**Use in IPM:** Scout fields in a grid like pattern at the onset of fruit initiation and spray at the first sign of disease.

**Use in resistance management:** Resistance management strategies should be established for the specific use area. If resistance occurs, use another chemical control with a different mode of action.

**Efficacy:** Unknown

**Active Ingredient:** Maneb (Maneb 80 WP)

**Formulation:** wettable powder

**Percent crop treated<sup>1</sup>:** 2.1 %

**Type of application:** foliar spray

**Rates:** 1.5-2 lb/A

**Timing:** Mid July until the end of harvest apply fungicides at first sign of disease on 7-14 days intervals.

**# applications/season:** < 21 lbs/A per season

**REI:** 12 hrs

**Pre-harvest interval:** 5 days

**Use in IPM:** Scout fields in a grid like pattern at the onset of fruit initiation and spray at the first sign of disease.

**Use in resistance management:** Resistance management strategies should be established for the specific use area. If resistance occurs, use another chemical control with a different mode of action.

**Efficacy:** Good

**Active Ingredient:** Maneb & zinc (Manex)

**Formulation:** flowable with zinc

**Percent crop treated<sup>1</sup>:** 5.1 %

**Type of application:** foliar spray

**Rates:** 1.2-1.6 qt/A

**Timing:** Mid July until the end of harvest apply fungicides at first sign of disease on 7-14 days intervals.

**# applications/season:** do not apply more than 12.8 qt/A per year

**REI:** 24 hrs

**Pre-harvest interval:** 5 days

**Use in IPM:** Scout fields in a grid like pattern at the onset of fruit initiation and spray at the first sign of disease.

**Use in resistance management:** Resistance management strategies should be established for the specific use area. If resistance occurs, use another chemical control with a different mode of action.

**Efficacy:** Excellent

**Active Ingredient:** Mefenoxam & chlorothalonil (Ridomil Gold/Bravo WP)

**Formulation:** wettable powder

**Percent crop treated<sup>1</sup>:** 13.7 %

**Type of application:** foliar spray

**Rates:** 2 lb/A

**Timing:** Mid July until the end of harvest at first sign of disease on 7-14 days intervals. Do not plant any crop in a treated field that is not

registered for use with this product for at least 12 months. Avoid late season applications when plants are beginning to senesce.

**# applications/season:** < 12.8 lbs/A per season

**REI:** 48 hrs

**Pre-harvest interval:** 7 days

**Use in IPM:** Scout fields in a grid like pattern at the onset of fruit initiation and spray at the first sign of disease.

**Use in resistance management:** Resistance management strategies should be established for the specific use area. If resistance occurs, use another chemical control with a different mode of action.

**Efficacy:** Good

**Active Ingredient:** Mefenoxam & manzate (Ridomil Gold MZ)

**Formulation:** wettable powder

**Percent crop treated<sup>1</sup>:** 8.5%

**Type of application:** foliar spray

**Rates:** 2.5 lb/A

**Timing:** Apply at the first sign of disease and repeat at 14-day intervals. Do not plant any crop in a treated field that is not registered for use with this product for at least 12 months. Avoid late season applications when plants are beginning to senesce.

**# applications/season:** <12.8 lbs/A per season

**REI:** 48 hrs

**Pre-harvest interval:** 5 days

**Use in IPM:** Scout fields in a grid like pattern at the onset of fruit initiation and spray at the first sign of disease.

**Use in resistance management:** Resistance management strategies should be established for the specific use area. If resistance occurs, use another chemical control with a different mode of action.

**Efficacy:** Excellent

**Alternatives:** Avoid extended periods of leaf wetness. Destroy infected crop debris and avoid splashing water when irrigating.

**Cultural control practices for disease management:**

**Planting dates:** none

**Resistant/Less desirable varieties:** none

**Row spacing:** none

**Biological Control:** none

**Post Harvest Control:** none

**ID: Anthracose (*Colletotrichum orgiculare*)**

**Frequency:** sporadic

**Damage:** Symptoms begin as water soaked spots on leaves that will turn tan in color with brown centers. Petioles can also become infected but most damage is noticed on the fruit. Circular water soaked lesions on the fruit surface will become inverted and ooze in wet humid conditions making fruit unmarketable. This disease does not require mechanical damage to infect but is mostly dependent on environmental conditions that are favorable for disease development such as temperature and rainfall. Do not plant susceptible plants in fields that were previously infected with anthracnose.

**Percent Acres infested<sup>1</sup>:** 22.1 %

**Control timing:** Mid season at the onset of runners, during extended periods of moist warm temperatures and also during post harvest storage and curing.

**Regional Differences:** none

### **Chemical Control**

**Active Ingredient:** Chlorothalonil (Bravo Ultrex 82 WDG)

**Formulation:** Water dispersible granules

**Percent crop treated<sup>1</sup>:** 8.1 %

**Type of application:** foliar spray

**Rates:** 1.8-2.7 lb/A

**Timing:** Mid season at the onset of runners, apply at the first sign of disease and repeat at 7-10 day intervals.

**# applications/season:** <12.8 lbs/A per season

**REI:** 12 hrs

**Pre-harvest interval:** 0 days

**Use in IPM:** Scout fields in a grid like pattern at the onset of runners and spray at the first sign of disease.

**Use in resistance management:** Resistance management strategies should be established for the specific use area. If resistance occurs, use another chemical control with a different mode of action.

**Efficacy:** Good/Fair

**Active Ingredient:** Maneb (Maneb 80 WP)

**Formulation:** wettable powder

**Percent crop treated<sup>1</sup>:** 1.8 %

**Type of application:** foliar spray

**Rates:** 1.5-2 lb/A

**Timing:** Mid season at the onset of runners, apply at the first sign of disease.

**# applications/season:** <21 lbs/A per season

**REI:** 24 hrs

**Pre-harvest interval:** 5 days

**Use in IPM:** Scout fields in a grid like pattern at the onset of runners and spray at the first sign of disease.

**Use in resistance management:** Resistance management strategies should be established for the specific use area. If resistance occurs, use another chemical control with a different mode of action.

**Efficacy:** Good

**Active Ingredient:** Maneb & zinc (Manex)

**Formulation:** wettable powder

**Percent crop treated<sup>1</sup>:** 9.6 %

**Type of application:** foliar spray

**Rates:** 1.2-1.6 qt/A

**Timing:** Mid season at the onset of runners, apply at the first sign of disease.

**# applications/season:** <12.8 lbs/A per season

**REI:** 24 hrs

**Pre-harvest interval:** 5 days

**Use in IPM:** Scout fields in a grid like pattern at the onset of runners and spray at the first sign of disease.

**Use in resistance management:** Resistance management strategies should be established for the specific use area. If resistance occurs, use another chemical control with a different mode of action.

**Efficacy:** Excellent

**Active Ingredient:** Thiophanate-methyl (Topsin-M 70W)

**Formulation:** wettable powder

**Percent crop treated<sup>1</sup>:** 7.1 %

**Type of application:** foliar spray

**Rates:** 4-6 oz/A

**Timing:** Mid season at the onset of runners, apply at the first sign of disease and repeat on 7-14 day intervals.

**# applications/season:** 1

**REI:** 12 hrs

**Pre-harvest interval:** 0 days

**Use in IPM:** Scout fields in a grid like pattern and spray at the first sign of disease.

**Use in resistance management:** Resistance management strategies should be established for the specific use area. If resistance occurs, use another chemical control with a different mode of action. Repeated use of Topsin may result in resistant strains of fungi and loss of disease control. Use sparingly each season.

**Efficacy:** Excellent/Good

**Alternatives:** Use no-till cover crops and plastic mulch, in growing systems to reduce fruit contact with the soil. Use certified disease free seeds, rotate away from cucurbits in infected fields. Minimize overhead irrigation to avoid water splashing which can move spores around fields. Plow under field immediately after harvest to reduce the possibility of overwintering spores. A minimum two-year rotation away from cucurbits is recommended.

**Cultural control practices for disease management:**

**Planting dates:** none

**Resistant/Less desirable varieties:** none

**Row spacing:** none

**Biological Control:** none

**Post Harvest Control:**

**ID: Black Rot (*Didymella bryoniae*)**

**Frequency:** annually

**Damage:** This disease is also referred to as gummy stem blight when it attacks the foliage and stems, and black rot when it attacks the fruit. Black rot can be incredibly destructive once it enters into a winter squash field. On fruit, sunken water soaked lesions will develop making fruit unmarketable. Extended periods of rainfall, a relative humidity of 85%, and leaf wetness periods between one and ten hours, all favor disease development. This disease can affect fruits in the field or post harvest and spread rapidly especially if fruits are damaged. Once damaged, fruit rot can occur within three days.

**Percent Acres infested<sup>1</sup>:** 28 %

**Control timing:** Mid July through harvest and into storage.

**Regional Differences:** none

## Chemical Control

**Active Ingredient:** Chlorothalonil (Bravo Ultrex 82 WDG)

**Formulation:** Water dispersible granules

**Percent crop treated<sup>1</sup>:** 16.8 %

**Type of application:** foliar spray

**Rates:** 1.8-2.7 lb/A

**Timing:** Begin application at the first sign of disease in mid July and repeat at 7-10 day intervals. Do not plant any crop in a treated field that is not registered for use with this product for at least 12 months.

**# applications/season:** < 12.8 lbs/A per season

**REI:** 12 hrs

**Pre-harvest interval:** 0 days

**Use in IPM:** Scout fields in a grid like pattern in mid July and spray at the first sign of disease.

**Use in resistance management:** Resistance management strategies should be established for the specific use area. To reduce risk of resistance development, growers should rotate fungicides, using other chemical controls with a different mode of action.

**Efficacy:** Excellent/Good

**Active Ingredient:** Maneb (Maneb 80 WP)

**Formulation:** wettable powder

**Percent crop treated<sup>1</sup>:** 5.3 %

**Type of application:** foliar spray

**Rates:** 1.5-2 lb/A

**Timing:** Begin application at the first sign of disease in mid July.

**# applications/season:** < 21 lbs/A per season

**REI:** 24 hrs

**Pre-harvest interval:** 5 days

**Use in IPM:** Scout fields in a grid like pattern in mid July and spray at the first sign of disease.

**Use in resistance management:** Resistance management strategies should be established for the specific use area. If resistance occurs, use another chemical control with a different mode of action.

**Efficacy:** Good

**Active Ingredient:** Maneb & zinc (Manex)

**Formulation:** wettable powder

**Percent crop treated<sup>1</sup>:** 9.3 %

**Type of application:** foliar spray

**Rates:** 1.2-1.6 qt/A

**Timing:** Begin application at the first sign of disease in mid July.

**# applications/season:** < 12.8 lbs/A per season

**REI:** 24 hrs

**Pre-harvest interval:** 5 days

**Use in IPM:** Scout fields in a grid like pattern in mid July and spray at the first sign of disease.

**Use in resistance management:** Resistance management strategies should be established for the specific use area. If resistance occurs, use another chemical control with a different mode of action.

**Efficacy:** Excellent/Good

**Active Ingredient:** Thiophanate-methyl (Topsin-M 70W)

**Formulation:** wettable powder

**Percent crop treated<sup>1</sup>:** 11.3 %

**Type of application:** foliar spray

**Rates:** 4-6 oz/A

**Timing:** Begin application in mid July at the first sign of disease and repeat at 7-14 day intervals.

**# applications/season:** 1

**REI:** 12 hrs

**Pre-harvest interval:** 0 days

**Use in IPM:** Scout fields in a grid like pattern in mid July and spray at the first sign of disease.

**Use in resistance management:** Resistance management strategies should be established for the specific use area. If resistance occurs, use another chemical control with a different mode of action. Repeated use of Benlate can lead to the development of resistant strains of fungi, use sparingly each season.

**Efficacy:** Excellent/Good

**Alternatives:** Use only certified disease free treated seed and practice a two-year rotation away from cucurbits. Avoid elongated periods of field wetness, if possible, which are favorable for disease development. Avoid injuring fruit during harvesting to avoid post harvest infection.

**Cultural control practices for disease management:**

**Planting dates:** none

**Resistant/Less desirable varieties:** none

**Row spacing:** none

**Biological Control:** none

**Post Harvest Control:**

**ID: Angular Leaf Spot (*Pseudomonas syringae* pv. *Lachrymans*)**

**Frequency:** sporadic

**Damage:** Disease will first appear on leaves as angular shaped lesions, which eventually become necrotic and spread to stems and petioles. When disease infects fruit, water soaked lesions develop. A white residue can sometimes be seen around infected areas on leaves and stems. Secondary soft rot infections can also occur.

**Percent Acres infested<sup>1</sup>:** 17.3 %

**Control timing:** Early to mid season when fruit set is initiated.

**Regional Differences:** none

### **Chemical Controls**

**Active Ingredient:** Basic copper sulfate (Basicop 53 WP)

**Formulation:** wettable powder

**Percent crop treated<sup>1</sup>:** 1.4 %

**Type of application:** foliar spray

**Rates:** 2 lb/A

**Timing:** at fruit set when disease first appears and every 7-10 days thereafter.

**# applications/season:** 2 lbs/A as often as needed

**REI:** 24 hrs

**Pre-harvest interval:** 0 days

**Use in IPM:** Scout fields mid season in a grid like pattern and spray at the first sign of disease.

**Use in resistance management:** Resistance management strategies should be established for the specific use area. If resistance occurs, use another chemical control with a different mode of action.

**Efficacy:** Excellent

**Active Ingredient:** Cupric hydroxide (Kocide 4.5F)

**Formulation:** liquid flowable

**Percent crop treated<sup>1</sup>:** 12.2 %

**Type of application:** foliar spray

**Rates:** 1.3-2 pt/A

**Timing:** spray at fruit set when disease development conditions exist.

**# applications/season:** 1-2 pts/A as often as needed

**REI:** 48 hrs

**Pre-harvest interval:** 0 days

**Use in IPM:** Scout fields at fruit set in a grid like pattern and spray at the first sign of disease.

**Use in resistance management:** Resistance management strategies should be established for the specific use area. If resistance occurs, use another chemical control with a different mode of action.

**Efficacy:** Good

**Active Ingredient:** Maneb (Manex)

**Formulation:** flowable with Zinc

**Percent crop treated**<sup>1</sup>: 7.4 %

**Type of application:** foliar spray

**Rates:** 1-1.2 qt/A

**Timing:** mid season at fruit set when disease development conditions exist.

**# applications/season:** <12.8 lbs/A per season

**REI:** 24 hrs

**Pre-harvest interval:** 7 days

**Use in IPM:** Scout fields at fruit set in a grid like pattern and spray at the first sign of disease.

**Use in resistance management:** Resistance management strategies should be established for the specific use area. If resistance occurs, use another chemical control with a different mode of action.

**Efficacy:** Excellent/Good

**Alternatives:** Avoid extended periods of leaf wetness, buy disease free seed, and rotate away from cucurbits for at least two years after infection. Destroy plant debris as soon as possible to avoid further infections.

**Cultural control practices for disease management:**

**Planting dates:** none

**Resistant/Less desirable varieties:** some butternuts

**Row spacing:** none

**Biological Control:** none

**Post Harvest Control:** none

**ID: Scab (*Cladosporium cucumerinum*)**

**Frequency:** sporadic

**Damage:** Initial symptoms appear as yellow pale-green spots on the leaves. A characteristic halo shaped ring will appear around the spot that will eventually become hollow. On fruit scabs are produced on the skin making the fruit misshapen and unmarketable. Spores of the causal agent germinate best at temperatures between 60° and 70° in extended periods of leaf wetness. Spores can overwinter in the vines of infected plants but may also be seed borne.

**Percent Acres infested<sup>1</sup>:** 11.7 %

**Control timing:** When vines begin to run in mid July.

**Regional Differences:** none

### **Chemical Control**

**Active Ingredient:** Chlorothalonil (Bravo Ultrex 82 WDG)

**Formulation:** Water dispersible granules

**Percent crop treated<sup>1</sup>:** 11.1 %

**Type of application:** foliar spray

**Rates:** 1.8-2.7 lb/A

**Timing:** When vines begin to run, apply at the first sign of disease and repeat at 7-10 day intervals. Do not plant any crop in a treated field that is not registered for use with this product for at least 12 months.

**# applications/season:** < 19.1 lbs/A per season

**REI:** 12 hrs

**Pre-harvest interval:** 0 days

**Use in IPM:** Scout fields in a grid like pattern when runners are sent and spray at the first sign of disease.

**Use in resistance management:** Resistance management strategies should be established for the specific use area. If resistance occurs, use another chemical control with a different mode of action.

**Efficacy:** Excellent/Good

**Alternatives:** Use of disease free seed is necessary, a two-year crop rotation away from cucurbits is recommended. Plant in well-drained soils in areas with good air circulation to avoid leaf wetness for extended periods. Protectant fungicides are recommended for control once the disease is found.

## **Cultural control practices for disease management:**

**Planting dates:** none

**Resistant/Less desirable varieties:** none

**Row spacing:** none

**Biological Control:** none

**Post Harvest Control:** none

**ID:** Phytophthora (*phytophthora capsici*)

**Frequency:** persistent

**Damage:** This disease has become increasingly problematic in the Northeast, as well as other parts of the country. The fungus causes such damage as: damping off, root and crown rot, stem lesions, vine collapse, foliar blights, leaf spots and fruit rot. The fungus is soil borne and thought to live in the soil indefinitely. Phytophthora has caused complete crop loss in years when extended periods of wetness and extensive rainfall have led to field saturation for over 24 hours.

Fruit rot starts with water soaked lesions which coalesce and cause fruit to actually melt in the field. Typically the side of the fruit that is in contact with the soil will develop characteristic white “fuzz” like growth. This “fuzz” is a collection of sporangia that will spread rapidly to healthy tissue in the field via rainfall and irrigation. Symptoms of the disease can also be found around the crown of the plants including cork like growth of cells gathered at the point of soil contact. Harvested fruit can also develop systems and should be discarded immediately to avoid further spread in the post harvest setting.

**Percent Acres infested<sup>1</sup>:** 7.3 %

**Control timing:** Mid-July through harvest.

**Regional Differences:** Disease occurrence may be more likely in areas of heavy moisture.

## **Chemical Control**

**Active Ingredient:** Fosetyl Al (Aliette WDG)

**Formulation:** Water dispersible granules

**Percent crop treated<sup>1</sup>:** 3.6 %

**Type of application:** foliar spray

**Rates:** 3-5 lb/A

**Timing:** Mid July through harvest at first sign of disease and repeat at 7-14 day intervals.

**# applications/season:** 1-7

**REI:** 12 hrs

**Pre-harvest interval:** 5 days

**Use in IPM:** Scout fields in mid July in a grid like pattern and spray at the first sign of disease.

**Use in resistance management:** Resistance management strategies should be established for the specific use area. If resistance occurs, use another chemical control with a different mode of action.

**Efficacy:** Excellent

**Alternatives:** Prevention is the key in controlling this disease. Preventative measures include avoiding planting in low lying areas or areas where water tends to collect. Do not plant susceptible crops in fields where phytophthora is suspected or has been present before. Isolate fields where phytophthora is suspected or found making sure there is no contact between tractors, workers, irrigation water or anything else that could be a potential vector of the fungal spores and. Avoid over watering and also make sure that you are using a water source that is free of phytophthora spores (this can be obtained by sending a water sample to a lab to be tested). To reduce fruit contact with bare soil, plant on plastic mulch or use a no-till system. Carefully inspect harvested fruit for symptoms before shipping to avoid post harvest spoilage.

**Cultural control practices for disease management:**

**Planting dates:** none

**Resistant/Less desirable varieties:** none

**Row spacing:** none

**Biological Control:** none

**Post Harvest Control:** none

**ID: Bacterial Wilt (*Erwinia tracheiphila*)**

**Frequency:** annually

**Damage:** This disease is caused by the bacterium *Erwinia tracheiphila* and is transmitted by insect vectors, primarily the striped cucumber beetle. Once plants are infected, the bacteria will multiply within the plant and spread throughout the vascular system. As the bacterium enters the vascular system the plant loses the ability to uptake water and nutrients. This may eventually kill the plant. New growth develops a brown “tufted” appearance while older leaves become necrotic and curled. Plants will appear to be suffering from drought stress or herbicide drift. Leaf samples from plants, which are thought to carry the disease, should be sent to a diagnostic lab for proper identification.

Once plants are infected with the bacteria, the effects are irreversible and the plant then becomes a source of inoculum for other beetles to feed on and then transmit to healthy plants. Vectoring beetles emerge from edges of the field in the spring and work their way in towards the center of the field. As feeding continues, disease transmission increases.

**Percent Acres effected<sup>1</sup>:** There is a potential for 100%

**Control timing:** To control the occurrence and spread of these bacteria, the striped cucumber beetle must be controlled. Early control is most important but cultural control measures should be carried out throughout the entire season.

**Yield losses:** Can be phenomenal

**Regional Differences:** none

**Chemical Controls:** see striped cucumber beetle control measures.

**Alternatives:** Some ways to control this disease include: controlling vectors, destroy infected crop debris, practice crop rotation, and use row cover to discourage feeding early on.

**Cultural control practices for disease management:**

**Planting dates:** none

**Resistant/Less desirable varieties:** none

**Row spacing:** none

**Biological Control:** see cucumber beetle control

**Post Harvest Control:** none

### **Cucurbit Viruses**

There are four primary mosaic viruses that infect winter squash. The four viruses consist of the cucumber mosaic virus (CMV), the watermelon mosaic virus (WMV), the papaya ring spot virus (PRSV) and the zucchini yellow mosaic virus (ZYMV). Aphids or other insect feeding can transmit these viruses. Characteristic effects of viral infection include mosaic yellowing on leaves, distorted new growth and overall stunted plant growth. Fruit may also appear smaller and discolored.

The best way to control the transmission and spread of these viruses is to control vectors (see chemical control for aphids). Cultural controls include planting resistant varieties, isolating late plantings from earlier planted cucurbit fields, sanitizing growing areas, and using reflective mulches and row covers to deter aphids from colonizing on young plants. Sanitation includes creating a

weed free environment and destroying any infected materials that can serve as a source of virus inoculum.

### **Post Harvest Diseases**

Post harvest infections are caused by a number of bacterial and fungal pathogens. Initial infection occurs in the field and then spreads in storage. Fungal pathogens that cause post harvest problems include: anthracnose, black rot, phytophthora, scab as well as secondary molds such as rhizoctonia and white mold. The best way to avoid these problems is to maintain an adequate fungicide program from fruit set to harvest in the field and also to create conditions that are unfavorable for disease development.

### **Weed Management for Winter Squash**

**ID:** **Broadleaf and Grass Weeds**

**Frequency:** annually

**Damage:** Competition between weeds and crop can reduce yields in heavily infested fields. Weeds can serve as host sites for insect pests and also as an inoculum source for diseases. High weed populations can also interfere with pesticide applications and harvesting.

**Percent Acres effected<sup>1</sup>:** 100%

**Pest Life Cycles:** Annual and perennial weeds are both a problem.

**Control timing:** preplant, preemergence or postemergence

**Yield losses:** 0-100% depending on severity.

**Regional Differences:** none

**Cultural Control Practices:** Shallow cultivation, hand hoeing and hand weeding before plants start vining are essential measures for continuous weed control in winter squash fields. Mowing, mulching and the use of black plastic can reduce weed populations and time spent on hand weeding later in the season.

**Biological Control Practices:** None

**Post-Harvest Control Practices:** Deep cultivation should be done after harvest to deter perennial weeds from establishing. Planting of cover crops after harvest, such as winter rye, can protect fields from weed seeds while also enriching the soil. Cover crops are grown in vacant fields to reduce germination

sites of weeds, protect the soil from wind and water erosion and most importantly improve soil fertility. Recommended Winter Rye rate is 115 lbs/A to ensure a well established cover crop. In the spring cover crops can be plowed under or rolled down for use in a no-till growing system.

## **Weed Control Methods**

### **Stale Seedbed**

**Description:** This method of weed control involves managing existing weeds before and after crop planting but prior to crop emergence. The theory behind this method is to kill weeds and potential weed seed that are located in the upper 1-2 inches of the soil surface by using a postemergence and preemergence herbicide. The seedbed is prepared a few weeks before planting and weed seeds are allowed to germinate and grow to the third or fourth leaf stage. Once the weeds have reached this stage a postemergence herbicide is applied to the soil. Crop seeding should be done after the postemergence herbicide is put down with as little soil disruption as possible. After seeding any registered preemergence herbicide can be put down as you normally would for further weed control. If using transplants, apply a postemergence herbicide just before planting and after planting apply a preemergence herbicide as you normally would. If done properly this control method will successfully eliminate many weeds that would otherwise interfere with crop production.

**Percent Acres Treated<sup>15</sup>:** 36%

### **Chemical Control**

**Active Ingredient:** Bensulide (Prefar 6E)

**Formulation:** emulsifiable liquid

**Percent crop treated<sup>15</sup>:** 6%

**Type of application:** foliar spray

**Rates:** 5-6 qt/A

**Timing:** Incorporate at the time of field preparation to provide some residual control of annual grasses. Can also be surface applied after seeding.

**# applications/season:** <6-lbs/A active ingredients per season

**REI:** 12 hrs

**Pre-harvest interval:** N/A

**Use in IPM:** none

**Use in resistance management:** none

**Efficacy:** Good

**Active Ingredient:** Glyphosate (Roundup Ultra 4S)

**Formulation:** soluble concentrate

**Percent crop treated**<sup>15</sup>: 23%

**Type of application:** foliar spray

**Rates:** 1-5 qt/A

**Timing:** this is a postemergence that should be applied after weeds have germinated and reached the true leaf stage. For control of annual and perennial weeds.

**# applications/season:** < 5.3 qt/A per season

**REI:** 12 hrs

**Pre-harvest interval:** 14 days

**Use in IPM:** none

**Use in resistance management:** none

**Efficacy:** Excellent/ Good

**Active Ingredient:** Paraquat (Gramoxone Max)

**Formulation:** liquid

**Percent crop treated**<sup>15</sup>: 12%

**Type of application:** foliar spray

**Rates:** 1.5-2.7 pt/A

**Timing:** This is a restricted use contact herbicide that should be used after weeds have reached the true leaf stage prior to crop planting. Use with a nonionic surfactant at 8-32oz/100 gal of spray.

**# applications/season:** 1

**REI:** 12 hrs

**Pre-harvest interval:** N/A

**Use in IPM:** Rotation with Roundup

**Use in resistance management:** none

**Efficacy:** Excellent

**Active Ingredient:** Pelargonic acid (Scythe 4.2)

**Formulation:** liquid concentrate

**Percent crop treated**<sup>15</sup>: 1%

**Type of application:** foliar spray

**Rates:** 3-10 gal/A

**Timing:** a postemergence contact herbicide that should be applied after planting, prior to crop emergence.

**# applications/season:** 1

**REI:** 24 hrs

**Pre-harvest interval:** N/A

**Use in IPM:** none

**Use in resistance management:** none

**Efficacy:** Fair

**Alternatives:** Use of cover crops, cultivation and hand hoeing.

### **Preplant Incorporated and Preemergence**

**Description:** This method of weed control involves applying an herbicide before planting seeds or transplants either as a foliar application to existing weeds or as a soil application. This can be done during field preparation in the weeks before planting takes place.

**Percent Acres Treated<sup>15</sup>:** 79%

### **Chemical Control**

**Active Ingredient:** Bensulide (Prefar 4E)

**Formulation:** emulsifiable concentrate

**Percent crop treated<sup>15</sup>:** 6%

**Type of application:** Preplant incorporated or preemergence

**Rates:** 5-6 qt/A

**Timing:** Use before planting and incorporate into the soil at least 2" deep primarily where grasses are a serious problem. May be applied preemergence if 1" of rainfall or irrigation follows.

**# applications/season:** <6-lbs/A active ingredients

**REI:** 12 hrs

**Pre-harvest interval:** N/A

**Use in IPM:** none

**Use in resistance management:** none

**Efficacy:** Good

**Active Ingredient:** Clomazone (Command ME)

**Formulation:** microencapsulated

**Percent crop treated<sup>15</sup>:** 26%

**Type of application:** soil application

**Rates:** 1-1/2 pt/A

**Timing:** Apply to soil surface after seeding crop.

**# applications/season:** 1

**REI:** 12 hrs

**Pre-harvest interval:** N/A

**Use in IPM:** none

**Use in resistance management:** none

**Efficacy:** Excellent

**Active Ingredient:** Ethalfluralin (Curbit 3EC)

**Formulation:** emulsifiable concentrate

**Percent crop treated**<sup>15</sup>: 41%

**Type of application:** Broadcast

**Rates:** 3-4.5 qt/A

**Timing:** Apply to soil surface immediately after planting. Do not incorporate. Works best with rainfall or irrigation within 5 days of planting. Do not apply under mulches, row covers or hot caps but can be banded between rows. Not recommended for use during cold wet weather.

**# applications/season:** 1

**REI:** 24 hrs

**Pre-harvest interval:** N/A

**Use in IPM:** none

**Use in resistance management:** none

**Efficacy:** Good

**Active Ingredient:** Ethalfluralin and Clomazone (Strategy)

**Formulation:** emulsifiable concentrate

**Percent crop treated**<sup>15</sup>: 32%

**Type of application:** soil application

**Rates:** 2-6 pts/A depending on soil type

**Timing:** Apply after planting prior to weed and crop emergence

**# applications/season:** 1

**REI:** 24 hrs

**Pre-harvest interval:** 45 days

**Use in IPM:** none

**Use in resistance management:** none

**Efficacy:** Good

**Active Ingredient:** Halosulfuron-methyl (Sanda)

**Formulation:** dry flowable

**Percent crop treated**<sup>15</sup>: 12%

**Type of application:** soil application

**Rates:** .5-.75 oz/A

**Timing:** Apply after planting but prior to soil cracking.

**# applications/season:** 2 (one is post emergence)

**REI:** 12 hrs

**Pre-harvest interval:** N/A

**Use in IPM:** none

**Use in resistance management:** none

**Efficacy:** Good

**Alternatives:** Use of cover crops, cultivation and hand hoeing.

## **Postemergence**

**Description:** Postemergence control involves using contact herbicides for weed control once weeds have reached the 4-5-leaf stage. These products may be used after crop emergence when weed populations are interfering with the growing system.

**Percent Acres Treated<sup>15</sup>:** 43%

## **Chemical control**

**Active Ingredient:** Clethodim (Select 2 EC)

**Formulation:** emulsifiable concentrate

**Percent crop treated<sup>15</sup>:** 5%

**Type of application:** foliar spray

**Rates:** 6-8 oz/A

**Timing:** Apply to actively growing grasses when they have reached the true leaf stage. Always use with a crop oil concentrate at a rate of 1 gal /100 gal of spray mix.

**# applications/season:** < 8 fl. oz/A per application as often as needed

**REI:** 24 hrs

**Pre-harvest interval:** 14 days

**Use in IPM:** none

**Use in resistance management:** none

**Efficacy:** Good

**Active Ingredient:** Halosulfuron-methyl (Sanda)

**Formulation:** dry flowable

**Percent crop treated<sup>15</sup>:** 12%

**Type of application:** foliar spray

**Rates:** .5-.75 oz/A

**Timing:** Apply after crop has reached the 2-5 true leaf stage but before the first female flowers appear.

**# applications/season:** 2 (one is post emergence)

**REI:** 12 hrs

**Pre-harvest interval:** N/A

**Use in IPM:** none

**Use in resistance management:** none

**Efficacy:** Good

**Active Ingredient:** Paraquat (Gramoxone Max 3S)

**Formulation:** liquid concentrate

**Percent crop treated**<sup>15</sup>: 6%

**Type of application:** foliar spray use with a protective shield.

**Rates:** 1.2 pt/A

**Timing:** apply when emerged weeds are 1-6 inches in height. Contact with crop can cause injury.

**# applications/season:** 1

**REI:** 12 hrs

**Pre-harvest interval:** N/A

**Use in IPM:** none

**Use in resistance management:** none

**Efficacy:** Excellent

**Active Ingredient:** Pelargonic acid (Scythe 4.2)

**Formulation:** emulsifiable concentrate

**Percent crop treated**<sup>15</sup>: 0

**Type of application:** foliar spray

**Rates:** 4-8 oz/gal for annual weeds, 6-9 oz/gal for perennial weeds, 9-13 oz/gal for maximum burn down.

**Timing:** Apply after weed emergence with a shielded sprayer, complete coverage is essential. Any contact with crop will cause injury.

**# applications/season:** 1 (but not used)

**REI:** 24 hrs

**Pre-harvest interval:** N/A

**Use in IPM:** none

**Use in resistance management:** none

**Efficacy:** Fair

**Active Ingredient:** Sethoxydim (Poast 1.5L)

**Formulation:** liquid concentrate

**Percent crop treated**<sup>15</sup>: 24%

**Type of application:** foliar spray

**Rates:** 1-2 pt/A

**Timing:** apply after weed emergence with oil concentration at 2pt/A to actively growing grasses. Do not cultivate for five days before application or for seven days after application.

**# applications/season:** < 3 pts/A per season

**REI:** 12 hrs

**Pre-harvest interval:** 14 days

**Use in IPM:** none

**Use in resistance management:** none

**Efficacy:** Good

**Alternatives:** Use of cover crops, cultivation and hand hoeing.

### **Vertebrate Pests**

Vertebrate pests of winter squash include the following: deer, mice, groundhogs, woodchucks, squirrels, chipmunks, crows, porcupine, voles, and rabbits. These vertebrates enter the field just before harvest to feed on ripe fruit and the seeds inside. Deer and woodchucks seem to be the most common problem and trample on plants while also feeding on them. A great deal of damage can be done from one feeding that is usually done around dawn and dusk.

### **Management Practices:**

**Deer:** off season permit, electric fence, fence, flash tape, garlic, ivory soap, moth balls, noise, dogs, planting alternative food source (sunflowers).

**Woodchucks:** leg traps, rifle, fence, smoke bombs, electric fence, live traps, and dogs.

**Crows:** scarecrow, dead crows, aluminum plates, row cover, shooting.

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