Crop Profile for Squash (Winter) in New England

Prepared: April 2006

General Production Information

- Regional ranking: 8th
- Contribution to US total: 3.24%
- Total acres grown: 4,727
- Production Costs/yearly: $1,493.42 (for Butternut Squash does not include land costs)
- % Fresh market[1]: 83%
- % Processing[1]: 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 well-drained sandy loam soil that is high in organic matter, with a pH of 6.5-6.8. The most common varieties grown in New England include Butternut (54%[1]), Buttercup (19%[1]), Acorn (11%[1]) and Hubbard (5%[1]). Direct seed planting (72%[1] 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%[1] of the growers 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 off 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, 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 and 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 and 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 rows 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. Hubbard and Butternut squash can be stored for 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[1]

Fresh market retail: 37.1%

U-Pick: 0.1%

Fresh market, wholesale: 46.1%

Processing: 13.7%

Other: 0.5%

Insect Pests

Striped Cucumber Beetle *(Acalymma vittata)*

Frequency: annually

Damage: Feeding on roots and cotyledons early in the season can kill small plants quickly. Striped cucumber beetles overwinter on the edges of fields, 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, whereas 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 high as 100% in severely infested areas.

Percent Acres Infested[1]: 78.2%

Timing of Control: 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 LossesYield Losses: can be phenomenal

Regional Differences: none

Chemical Controls

Active Ingredient: Carbaryl (Sevin XLR Plus)

Formulations: emulsifiable concentrate

Percent crop treated[1]: 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[1]: 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[1]: 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[1]: 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[1]: 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

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[1]: 25.2%

Timing of Control: 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[1]: 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[1]: 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[1]: 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

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[1]: 21.9%

Timing of Control: 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[1]: 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[1]: 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[1]: 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 determine 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

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[1]: 18.5%

Timing of Control: 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[1]: .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[1]: 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[1]: 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[1]: 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[1]: 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).

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[1]: 3.1%

Timing of Control: 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

Diseases

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[1]: 51.2 %

Timing of Control: 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[1]: 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[1]: 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: 1day

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[1]: 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[1]: 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[1]: 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 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

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; they 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[1]: 21.5%

Timing of Control: Mid-July until the end of harvest when conditions are conducive to disease development.

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[1]: 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[1]: 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[1]: 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[1]: 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[1]: 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

Anthracnose (***Colletotrichum orgiculare)***

Frequency: sporadic

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[1]: 28 %

Timing of Control: 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[1]: 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[1]: 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[1]: 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[1]: 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:

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[1]: 17.3 %

Timing of Control: 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[1]: 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[1]: 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[1]: 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

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[1]: 11.7 %

Timing of Control: 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[1]: 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

Phytophthora (*phytophthora capsici)*

Frequency: persistent

Damage: This disease has become increasingly problematic in the Northeast, as well as in 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[1]: 7.3 %

Timing of Control: 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[1]: 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 (determined 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

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 take up 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. The plant then becomes a source of inoculum for other beetles to feed on and transmit to healthy plants. Vectoring beetles emerge from edges of the field in the spring and work their way towards the center of the field. As feeding continues, disease transmission increases.

Percent Acres effected[1]: There is a potential for 100%

Timing of Control: 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: control vectors, destroy infected crop debris, practice crop rotation, and use row covers to discourage early feeding.

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: 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, and 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.

Weeds

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[1]: 100%

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

Timing of Control: 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: Cultivate deeply 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. Seed the crop with as little soil disruption as possible after the postemergence herbicide is applied. 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. 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[15]: 36%

Chemical Control

Active Ingredient: Bensulide (Prefar 6E)

Formulation: emulsifiable liquid

Percent crop treated[15]: 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[15]: 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[15]: 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[15]: 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[15]: 79%

Chemical Control

Active Ingredient: Bensulide (Prefar 4E)

Formulation: emulsifiable concentrate

Percent crop treated[15]: 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[15]: 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[15]: 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[15]: 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 (Sandea)

Formulation: dry flowable

Percent crop treated[15]: 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[15]: 43%

Chemical control

Active Ingredient: Clethodim (Select 2 EC)

Formulation: emulsifiable concentrate

Percent crop treated[15]: 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 (Sandea)

Formulation: dry flowable

Percent crop treated[15]: 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[15]: 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[15]: 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[15]: 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.

Vertebrates

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, can damage plants in only one feeding, and often trample plants. Feeding usually occurs at 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.

Contacts

Contributors

Connecticut: Candace Bartholomew
University of Connecticut
Cooperative Extension
1800 Asylum Avenue
West Hartford, CT 06117
(860) 570-9067
cbarthol@canr1.cag.uconn.edu

Maine: Glen Koehler

University of Maine Cooperative Extension
Pest Management Office
491 College Avenue
Orono, ME 04473-1295
(207) 581-3882
gkoehler@umext.maine.edu

Maine: James Dill
University of Maine Cooperative Extension
Pest Management Office
491 College Avenue
Orono, ME 04473-1295
(207) 581-3879
jdill@umext.maine.edu

Massachusetts: Natalia Clifton
University of Massachusetts
Pesticide Education
212 Ag Engineering Bldg.
Amherst, MA 01003
(413) 545-1044
nclifton@ent.umass.edu

Massachusetts: Richard Bonanno
Weed Scientist
University of Massachusetts
255 Merrimack St
>Methuen, MA 01844
Tel: 978-361-5650
Rbonanno@umext.umass.edu

New Hampshire: Alan T. Eaton
University of New Hampshire
Spaulding Hall
38 College Rd.
Durham, NH 03824
Phone: (603) 862-1734
Fax : (603) 862-1713
Email: Alan.Eaton@unh.edu

New Hampshire: George Hamilton
Extension Educator, Ag Resources
University of New Hampshire Cooperative Ex- Hillsborough County
329 Mast Rd
Goffstown, NH 030455
Tel:(603) 882-9919
Fax: (603)645-5252
george.hamilton@unh.edu

Rhode Island: Peggy Siligato
University of Rhode Island coop. Extension
3 East Alumni Ave
Kingston, RI 02881
(401) 874-5997
siligato@uriacc.uri.edu

Vermont: Ann Hazelrigg
Plant & Soil Science Department
105 Carrigan Drive
University of Vermont
Burlington, VT 05405-0082
(802) 656-0493
ann.hazelrigg@uvm.edu

Vermont: Sarah Kingsley-Richards
Plant & Soil Science Dept.
105 Carrigan Drive
University of Vermont

Burlington, VT 05405-0082
(802) 656-0475
sarah.kingsley@uvm.edu

Reviewers

Maine: Glen Koehler
University of Maine Cooperative Extension
Pest Management Office
491 College Avenue
Orono, ME 04473-1295
(207) 581-3882
gkoehler@umext.maine.edu

Maine: James Dill
University of Maine Cooperative Extension
Pest Management Office
491 College Avenue
Orono, ME 04473-1295
(207) 581-3879
jdill@umext.maine.edu

Massachusetts: Richard Bonanno
Weed Scientist
University of Massachusetts
255 Merrimack St
Methuen, MA 01844
Tel: 978-361-5650
Rbonanno@umext.umass.edu

Massachusetts: Natalia Clifton
University of Massachusetts
Pesticide Education
212 Ag Engineering Bldg.
Amherst, MA 01003
(413) 545-1044
nclifton@ent.umass.edu

Massachusetts: Andrew Cavanagh
Department of Plant, Soil and Insect Sciences
Division of Entomology
301 Agricultural Engineering Bldg.
250 Natural Resources Rd.
University of Massachusetts Amherst
Amherst, Mass. 01003
TEL: (413) 545-3696 / (413) 577-3976
FAX: (413) 545-5858
acavanagh@psis.umass.edu

Rhode Island: Peggy Siligato
University of Rhode Island Cooperative Extension
3 East Alumni Ave
Kingston, RI 02881
(401) 874-5997
siligato@uriacc.uri.edu

Vermont: Ann Hazelrigg
Plant & Soil Science Department
105 Carrigan Drive
University of Vermont
Burlington, VT 05405-0082
(802) 656-0493
ann.hazelrigg@uvm.edu

Compiled for the New England Pest Management Network by:
Natalia P. Clifton and Amanda Duphily
University of Massachusetts
Department of Plant, Soil, and Insect Sciences; 250 Natural Resources Rd.; Amherst, MA 01003

Telephone: (413) 545-1044
nclifton@psis.umass.edu

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