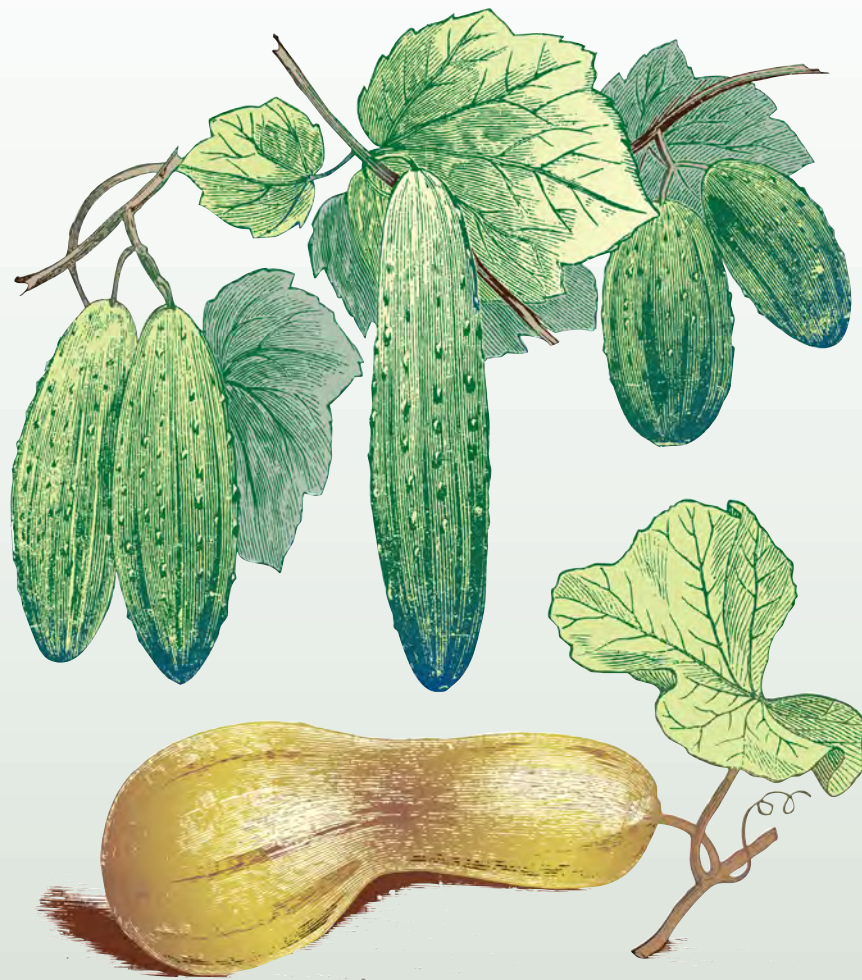
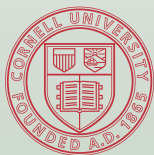


2016

Organic Production and IPM Guide for Cucumbers and Squash



NYS IPM Publication No. 135



Cornell University
Cooperative Extension



New York State
Department of
Agriculture & Markets

2016 PRODUCTION AND IPM GUIDE FOR ORGANIC CUCUMBER & BUTTERNUT SQUASH FOR PROCESSING

Coordinating Editor

Abby Seaman* (NYS IPM Program)

Contributors and Resources

Brian Caldwell (Cornell University, Organic Cropping Systems Project)

Vern Grubinger (University of Vermont, Vegetable and Berry Specialist)

Beth Gugino (The Pennsylvania State University, Department of Plant Pathology)

Robert Hadad (Cornell Vegetable Program)

Michael Helms* (Cornell University, Pesticide Management Education Program)

Margaret T. McGrath* (Cornell University, Section of Plant Pathology and Plant Microbe Biology)

Charles L. Mohler (Cornell University, Section of Soil and Crop Sciences, retired)

Brian Nault* (Cornell University, Department of Entomology)

Richard Pedersen (Pedersen Farms)

Anu Rangarajan (Cornell University Horticulture-SIPS, Vegetable Crop Production)

Thomas A. Zitter (Cornell University, Section of Plant Pathology and Plant Microbe Biology, retired)

**Pesticide Information and Regulatory Compliance*

Staff Writers

Mary Kirkwyland and Elizabeth Thomas (New York State IPM Program)

Editing for the 2016 update

Mary Kirkwyland (Cornell University, NYSAES, New York State IPM Program)

Special Appreciation

Format based on the Integrated Crop and Pest Management Guidelines for Commercial Vegetable Production.

<https://ipmguidelines.org/> Content Editors Stephen Reiners, Curtis H. Petzoldt, and Abby Seaman, with numerous Discipline Editors

Funded in part by the New York State Department of Agriculture and Markets

The information in this guide reflects the current authors' best effort to interpret a complex body of scientific research, and to translate this into practical management options. Following the guidance provided in this guide does not assure compliance with any applicable law, rule, regulation or standard, or the achievement of particular discharge levels from agricultural land.

Every effort has been made to provide correct, complete, and up-to-date pest management information for New York State at the time this publication was released for printing (June 2016). Changes in pesticide registrations and regulations, occurring after publication are available in county Cornell Cooperative Extension offices or from the Pesticide Management Education Program web site (<http://pmep.cce.cornell.edu>). Trade names used herein are for convenience only. No endorsement of products is intended, nor is criticism of unnamed products implied.

This guide is not a substitute for pesticide labeling. Always read the product label before applying any pesticide.

Updates and additions to this guide are available at <http://nysipm.cornell.edu/resources/publications/organic-guides>. Please submit comments or suggested changes for these guides to organicguides@gmail.com.

How to cite this publication: Seaman, Abby, Editor. (2016) <i>Production Guide for Organic Cucumber and Butternut Squash for Processing</i> . Publisher: New York State Integrated Pest Management Program, Cornell University (New York State Agricultural Experiment Station, Geneva, NY). 74 pages.
--

Contents

INTRODUCTION	3
1. General Organic Management Practices	3
1.1 Organic Certification.....	3
1.2 Organic System Plan.....	3
2. Soil Health	3
3. Cover Crops	4
3.1 Goals and Timing for Cover Crops.....	4
3.2 Legume Cover Crops.....	4
3.3 Non-Legume Cover Crops.....	4
3.4 Biofumigant Cover Crops.....	5
4. Field Selection	7
4.1 Certifying Requirements.....	7
4.2 Crop Rotation Plan.....	8
4.3 Pest History.....	9
4.4 Soil and Air Drainage.....	9
5. Weed Management	9
5.1 Record Keeping.....	10
5.2 Weed Management Methods.....	10
6. Recommended Varieties	10
7. Planting Methods	12
7.1 Cucumber.....	12
7.2 Winter squash.....	12
8. Crop & Soil Nutrient Management	12
8.1 Fertility.....	13
8.2 Preparing an Organic Nutrient Budget.....	14
9. Harvesting	17
9.1 Cucumber.....	17
9.2 Winter Squash.....	17
10. Using Organic Pesticides	17
10.1 Sprayer Calibration and Application.....	17
10.2 Regulatory Considerations.....	17
10.3 Pollinator Protection.....	18
10.4 Optimizing Pesticide Effectiveness.....	18
11. Disease Management	19
11.1 MANAGEMENT OF COMMON DISEASES.....	22
11.2 Management of Nematodes.....	31
11.3 MANAGEMENT OF DISEASES THAT OCCUR LESS FREQUENTLY.....	32
12. Nonpathogenic Disorders	51
13. Insect Management	51
14. Pesticides & Abbreviations Mentioned in this Publication	67
15. References	70
16. World Wide Web Links	71

INTRODUCTION

This guide for organic production of pickling cucumbers and butternut squash provides an outline of cultural and pest management practices and includes topics that have an impact on improving plant health and reducing pest problems. It is divided into sections, but the interrelated quality of organic cropping systems makes each section relevant to the others.

The guide attempts to compile the most current information available, but acknowledges that effective means of control are not available for some pests. More research on growing crops organically is needed, especially in the area of pest management. Future revisions will incorporate new information, providing organic growers with a complete set of useful practices to help them achieve success.

This guide uses the term Integrated Pest Management (IPM), which like organic production, emphasizes cultural, biological, and mechanical practices to minimize pest outbreaks. With limited pest control products available for use in many organic production systems, an integrated approach to pest management is essential. IPM techniques such as identifying and assessing pest populations, keeping accurate pest history records, selecting the proper site, and preventing pest outbreaks through use of crop rotation, resistant varieties and biological controls are important to producing a high quality crop.

1. GENERAL ORGANIC MANAGEMENT PRACTICES

1.1 Organic Certification

To use a certified organic label, farming operations that gross more than \$5,000 per year in organic products must be certified by a U.S. Department of Agriculture National Organic Program (NOP) accredited certifying agency. The choice of certifier may be dictated by the processor or by the target market. [A list of accredited certifiers](#) (Link 7) operating in New York can be found on the New York State Department of Agriculture and Markets [Organic Farming Development/Assistance](#) web page (Link 8). See more certification and regulatory details under Section 4.1 *Certification Requirements* and Section 10: *Using Organic Pesticides*.

1.2 Organic System Plan

An organic system plan (OSP) is central to the certification process. The OSP describes production, handling, and record-keeping systems, and demonstrates to certifiers an understanding of organic practices for a specific crop. The process of developing the plan can be very valuable in terms of anticipating potential issues and challenges, and fosters thinking of the farm as a whole

system. Soil, nutrient, pest, and weed management are all interrelated on organic farms and must be managed in concert for success. Certifying organizations may be able to provide a template for the farm plan. The following description of the organic system plan is from the USDA [National Organic Program Handbook](#):

“A plan of management of an organic production or handling operation that has been agreed to by the producer or handler and the certifying agent and that includes written plans concerning all aspects of agricultural production or handling described in the Organic Food Production Act of 1990 and the regulations in [Subpart C](#), Organic Production and Handling Requirements.”

The [National Sustainable Agriculture Information Service](#), (formerly ATTRA), has produced a [Guide for Organic Crop Producers](#) that includes a chapter on writing the organic system plan. The [Rodale Institute](#) has also developed resources for transitioning to organic and developing an organic system plan.

2. SOIL HEALTH

Healthy soil is the basis of organic farming. Regular additions of organic matter in the form of cover crops, compost, or manure create a soil that is biologically active, with good structure and capacity to hold nutrients and water (note that any raw manure applications should occur at least 120 days before harvest). Decomposing plant materials will activate a diverse pool of microbes, including those that break down organic matter into plant-available nutrients as well as others that compete with plant pathogens on the root surface.

Rotating between crop families can help prevent the buildup of diseases that overwinter in the soil. Rotation with a grain crop, preferably a crop or crops that will be in place for one or more seasons, deprives disease-causing organisms of a host, and also contributes to a healthy soil structure that promotes vigorous plant growth. The same practices are effective for preventing the buildup of root damaging nematodes in the soil, but keep in mind that certain grain crops are also hosts for some nematode species. Rotating between crops with late and early season planting dates can help prevent the buildup of weed populations. Organic growers must attend to the connection between soil, nutrients, pests, and weeds to succeed. An excellent resource for

additional information on soils and soil health is [Building Soils for Better Crops](#) (Link 16) by Fred Magdoff and Harold Van Es, 2010. For more information, refer to the [Cornell Comprehensive Assessment of Soil Health website](#) (Link 17).

3. COVER CROPS

Unlike cash crops, which are grown for immediate economic benefit, cover crops are grown for their valuable effect on soil properties and on subsequent cash crops. Cover crops help maintain soil organic matter, improve soil tilth, prevent erosion and assist in nutrient management. They can also contribute to weed management, increase water infiltration, maintain populations of beneficial fungi, and may help control insects, diseases and nematodes. To be effective, cover crops should be treated as any other valuable crop on the farm, carefully considering their cultural requirements, life span, mowing recommendations, incorporation methods, and susceptibility, tolerance, or antagonism to root pathogens and other pests. Some cover crops and cash crops share susceptibility to certain pathogens and nematodes. Careful planning and monitoring is required when choosing a cover crop sequence to avoid increasing pest problems in subsequent cash crops. See Tables 3.1 and 3.2 for more information on specific cover crops and Section 8: *Crop and Soil Nutrient Management* for more information about how cover crops fit into a nutrient management plan.

A certified organic farmer is required to plant certified organic cover crop seed. If, after contacting at least three suppliers, organic seed is not available, then the certifier may allow conventional seed to be used. Suppliers should provide a purity test for cover crop seed. Always inspect the seed for contamination with weed seeds and return if it is not clean. Cover crop seed is a common route for introduction of new weed species onto farms.

3.1 Goals and Timing for Cover Crops

Adding cover crops regularly to the crop rotation plan can result in increased yields of the subsequent cash crop. Goals should be established for choosing a cover crop; for example, to add nitrogen, smother weeds, or break a pest cycle. The cover crop might best achieve some of these goals if it is in place for the entire growing season. If this is impractical, a compromise might be to grow the cover crop between summer cash crops. Allow two or more weeks between cover crop incorporation and cash crop seeding to permit decomposition of the cover crop, which will improve the seedbed and help avoid any unwanted allelopathic effects on the next cash crop. Another option is to overlap the cover crop and the cash crop life cycles by overseeding, interseeding or intercropping the cover crop between cash

crop rows at final cultivation. An excellent resource for determining the best cover crop for your situation is [Northeast Cover Crop Handbook](#) (Reference 21), by Marianne Sarrantonio or the [Cornell online decision tool](#) (Link 15) to match goals, season, and cover crop.

Leaving cover crop residue to remain on the soil surface might make it easier to fit into a crop rotation and will help to conserve soil moisture, but some of the nitrogen contained in the residue will be lost to the atmosphere, and total organic matter added to the soil will be reduced. Turning under the cover crop will speed up the decomposition and nitrogen release from the crop residue.

3.2 Legume Cover Crops

Legumes are the best cover crop for increasing available soil nitrogen. Legumes have symbiotic bacteria called rhizobia, which live in their roots and convert atmospheric nitrogen gas in the soil pores to ammonium, a form of nitrogen that plant roots can use. When the cover crop is mowed, winter killed or incorporated into the soil, the nitrogen is released and available for the next crop. Because most of this nitrogen was taken from the air, there is a net nitrogen gain to the soil (See Table 3.1). Assume approximately 50 percent of the fixed nitrogen will be available for the crop to use in the first season, but this may vary depending on the maturity of the legume, environmental conditions during decomposition, the type of legume grown, and soil type..

It is common to inoculate legume seed with rhizobia prior to planting, but the inoculant must be approved for use in organic systems. Request written verification of organic approval from the supplier and confirm this with your organic farm certifier prior to inoculating seed.

Interseeding Red Clover into Cucurbits

Red clover may be interseeded into vining type winter squash at a rate of 10-15 lbs/acre at last cultivation, just before the plants start to run. The seed may be spun on while cultivating, or in a separate pass immediately after. The clover will germinate and establish under the plant canopy and continue to grow after frost kills the vines. Left to grow for the next season, it can provide enough nitrogen to meet the requirement for heavy nitrogen feeders the following season. Alternately, the clover can be cut for hay, but this will result in less nitrogen returned to the soil.

3.3 Non-Legume Cover Crops

Barley, rye grain, rye grass, Sudangrass, wheat, oats, and other grain crops left on the surface or plowed under as green manures or dry residue in the spring are beneficial because they capture nitrogen that otherwise might be

leached from the soils. If incorporated, allow two weeks or more for decomposition prior to planting to avoid the negative impact on stand establishment from actively decomposing material. Three weeks might not be enough if soils are very cold. In wet years, the presence of cover crop residues may increase slug damage.

3.4 Biofumigant Cover Crops

Certain cover crops have been shown to inhibit weeds, pathogens, and nematodes by releasing toxic volatile chemicals when tilled into the soil as green manures and degraded by microbes or when cells are broken down by finely chopping. Degradation is quickest when soil is warm and moist. These biofumigant cover crops include Sudangrass, sorghum-sudangrasses, and many in the brassica family. Varieties of mustard and arugula developed with high glucosinolate levels that maximize biofumigant activity have been commercialized (e.g. Caliente brands 199 and Nemat).

Attend to the cultural requirements of the cover crops to maximize growth. Fertilizer applied to the cover crops will be taken up and then returned to the soil for use by the cash crop after the cover crop is incorporated. Biofumigant cover crops like mustard should be allowed to grow to their full

size, normally several weeks after flowering starts, but incorporated before the seeds become brown and hard indicating they are mature. To minimize loss of biofumigant, finely chop the tissue early in the day when temperatures are low. Incorporate immediately by tilling, preferably with a second tractor following the chopper. Lightly seal the soil surface using a culti-packer and/or 1/2 inch of irrigation or rain water to help trap the volatiles and prolong their persistence in the soil. Wait at least two weeks before planting a subsequent crop to reduce the potential for the breakdown products to harm the crop, also known as phytotoxicity. Scratching the soil surface before planting will release remaining biofumigant. This biofumigant effect is not predictable or consistent. The levels of the active compounds and suppressiveness can vary by season, cover crop variety, maturity at incorporation, amount of biomass, fineness of chopping, how quickly the tissue is incorporated, soil microbial diversity, soil tilth, and microbe population density.

[Cover Crops for Vegetable Growers: Decision Tool](#) (Link 15).

[Northeast Cover Crops Handbook](#) (Reference 21).

[Cover Crops for Vegetable Production in the Northeast](#) (Reference 23).

[Crop Rotation on Organic Farms: A Planning Manual](#) (Link 18).

ORGANIC CUCUMBER & BUTTERNUT SQUASH PRODUCTION

Table 3.1 Leguminous Cover Crops: Cultural Requirements, Nitrogen Contributions and Benefits.

SPECIES	PLANTING DATES	LIFE CYCLE	COLD HARDINESS ZONE	HEAT	DROUGHT	SHADE	pH PREFERENCE	SOIL TYPE PREFERENCE	SEEDING (lb/A)	NITROGEN FIXED (lb/A) ^a	COMMENTS
				TOLERANCES							
CLOVERS											
Alsike	April-May	Biennial/ Perennial	4	5	5	6	6.3	Clay to silt	4-10	60-119	+Endures waterlogged soils & greater pH range than most clovers
Berseem	Early spring	Summer annual/ Winter annual ^b	7	6-7	7-8	5	6.5-7.5	Loam to silt	9-25	50-95	+Good full-season annual cover crop
Crimson	Spring	Summer annual/ Winter annual ^b	6	5	3	7	5.0-7.0	Most if well-drained	9-40	70-130	+Quick cover +Good choice for overseeding (shade tolerant) + Sometimes hardy to zone 5.
Red	Very early spring or late summer	Short-lived perennial	4	4	4	6	6.2-7.0	Loam to clay	7-18	100-110	+Strong taproot, good heavy soil conditioner +Good choice for overseeding (shade tolerant)
White	Very early spring or late summer	Long-lived perennial	4	6	7	8	6.2-7.0	Loam to clay	6-14	≤130	+Good low maintenance living cover +Low growing +Hardy under wide range of conditions
SWEET CLOVERS											
Annual White	Very early spring	Summer annual ^b	NFT	6-7	6-7	6	6.5-7.2	Most	15-30	70-90	+Good warm weather smother & catch crop +Rapid grower +High biomass producer
Biennial White and Yellow	Early spring-late summer	Biennial	4	6	7-8	4	6.5-7.5	Most	9-20	90-170	+Deep taproot breaks up compacted soils & recycles nutrients +Good catch crop +High biomass producer
OTHER LEGUMES											
Cowpeas	Late spring-late summer	Summer annual ^b	NFT	9	8	6	5.5-6.5	Sandy loam to loam	25-120	130	+Rapid hot weather growth
Fava Beans	April-May or July-August	Summer annual ^b	8	3	4	NI	5.5-7.3	Loam to silty clay	80-170 small seed 70-300 lg seed	71-220	+Strong taproot, good conditioner for compacted soils + Excellent cover & producer in cold soils +Efficient N-fixer
Hairy Vetch	Late August-early Sept.	Summer annual/ Winter annual	4	3	7	5	6.0-7.0	Most	20-40	80-250 (110 ave.)	+Prolific, viney growth +Most cold tolerant of available winter annual legumes
Field Peas	March-April OR late summer	Winter annual/ Summer annual ^b	7	3	5	4	6.5-7.5	Clay loam	70-220	172-190	+Rapid growth in chilly weather

NI=No Information, NFT=No Frost Tolerance. Drought, Heat, Shade Tolerance Ratings: 1-2=low, 3-5=moderate, 6-8=high, 9-10=very high. ^a Nitrogen fixed but not total available nitrogen. See Section 8 for more information. ^b Winter killed.

Reprinted with permission from Rodale Institute®, <http://www.rodaleinstitute.org/>, M. Sarrantonio. 1994. Northeast Cover Crop Handbook. (Reference 21).

ORGANIC CUCUMBER & BUTTERNUT SQUASH PRODUCTION

Table 3.2 Non-leguminous Cover Crops: Cultural Requirements and Crop Benefits

SPECIES	PLANTING DATES	LIFE CYCLE	COLD HARDINESS ZONE	HEAT	DROUGHT	SHADE	PH PREFERENCE	SOIL TYPE PREFERENCE	SEEDING (LB/A)	COMMENTS
				--TOLERANCES--						
Brassicas e.g. mustards, rapeseed	April or late August-early Sept.	Annual / Biennial ^b	6-8	4	6	NI	5.3-6.8	Loam to clay	5-12	+Good dual purpose cover & forage +Establishes quickly in cool weather +Biofumigant properties
Buckwheat	Late spring-summer	Summer annual ^b	NFT	7-8	4	6	5.0-7.0	Most	35-134	+Rapid grower (warm season) +Good catch or smother crop +Good short-term soil improver for poor soils
Cereal Rye	August-early October	Winter annual	3	6	8	7	5.0-7.0	Sandy to clay loams	60-200	+Most cold-tolerant cover crop +Excellent allelopathic weed control +Good catch crop +Rapid germination & growth +Temporary N tie-up when turned under
Fine Fescues	Mid March-mid-May OR late Aug.-late Sept.	Long-lived perennial	4	3-5	7-9	7-8	5.3-7.5 (red) 5.0-6.0 (hard)	Most	16-100	+Very good low-maintenance permanent cover, especially in infertile, acid, droughty &/or shady sites
Oats	Mid-Sept-early October	Summer annual ^b	8	4	4	4	5.0-6.5	Silt & clay loams	110	+Rapid growth +Ideal quick cover and nurse crop
Ryegrasses	August-early Sept.	Winter annual (AR)/ Short-lived perennial (PR)	6 (AR) 4 (PR)	4	3	7 (AR) 5 (PR)	6.0-7.0	Most	14-35	+Temporary N tie-up when turned under +Rapid growth +Good catch crop +Heavy N & moisture users
Sorghum-Sudangrass	Late spring-summer	Summer Annual ^b	NFT	9	8	NI	Near neutral	NI	10-36	+Tremendous biomass producers in hot weather +Good catch or smother crop +Biofumigant properties

NI-No Information, NFT-No Frost Tolerance. Drought, Heat, Shade Tolerance Ratings: 1-2=low, 3-5=moderate, 6-8=high, 9-10=very high. AR=Annual Rye, PR=Perennial Rye. ^bWinter killed. Reprinted with permission from Rodale Institute®, <http://www.rodaleinstitute.org/>, M. Sarrantonio. 1994. Northeast Cover Crop Handbook. (Reference 21).

4. FIELD SELECTION

For organic production, give priority to fields with excellent soil tilth, high organic matter, good drainage and airflow.

4.1 Certifying Requirements

Certifying agencies have requirements that affect field selection. Fields cannot be treated with prohibited products for three years prior to the harvest of a certified organic crop. Adequate buffer zones are required between certified organic and conventionally grown crops. Buffer zones must

be a barrier, such as a diversion ditch or dense hedgerow, or be a distance large enough to prevent drift of prohibited materials onto certified organic fields. Determining what buffer zone is needed will vary depending on equipment used on adjacent non-certified land. For example, use of high-pressure spray equipment or aerial pesticide applications in adjacent fields will increase the buffer zone size. Pollen from genetically engineered crops can also be a contaminant. An organic crop should not be grown near a genetically engineered crop of the same species. Check with your certifier for specific buffer requirements. These buffers

commonly range between 20 to 250 feet depending on adjacent field practices.

4.2 Crop Rotation Plan

A careful crop rotation plan is the cornerstone of organic crop production because it allows the grower to improve soil quality and proactively manage pests. Although growing a wide range of crops complicates the crop rotation planning process, it ensures diversity in crop residues in the soil, and a greater variety of beneficial soil organisms. Individual organic farms vary widely in the crops grown and their ultimate goals, but some general rules apply to all organic farms regarding crop rotation. Rotating individual fields away from crops within the same family is critical and can help minimize crop-specific disease and non-mobile insect pests that persist in the soil or overwinter in the field or field borders. Pests that are persistent in the soil, have a wide host range, or are wind-borne, will be difficult to control through crop rotation. Conversely, the more host specific, non-mobile, and short-lived a pest is, the greater the ability to control it through crop rotation. The amount of time required for a crop rotation is based on the particular pest and its severity. Some particularly difficult pests may require a period of fallow. See specific recommendations in the disease and insect sections of this guide (Sections 11, 12, 13). Partitioning the farm into management units will help to organize crop rotations and ensure that all parts of the farm have sufficient breaks from each type of crop.

A well-planned crop rotation is key to weed management. Short season crops such as lettuce and spinach are harvested before many weeds go to seed, whereas vining cucurbits, with their limited cultivation time and long growing season, allow weeds to go to seed before harvest. Including short season crops in the rotation will help to reduce weed populations provided the field is cleaned up promptly after harvest. Other weed reducing rotation strategies include growing mulched crops, competitive cash crops, short-lived cover crops, or crops that can be intensively cultivated. Individual weed species emerge and mature at different times of the year, therefore alternating between spring, summer, and fall planted crops helps to interrupt weed life cycles.

Cash and cover crop sequences should also take into account the nutrient needs of different crops and the

response of weeds to high nutrient levels. High soil phosphorus and potassium levels can exacerbate problem weed species. A cropping sequence that alternates crops with high and low nutrient requirements can help keep nutrients in balance. The crop with low nutrient requirements can help use up nutrients from a previous heavy feeder. A fall planting of a non-legume cover crop will help hold nitrogen not used by the previous crop. This nitrogen is then released when the cover crop is incorporated in the spring. See Section 5: *Weed Management*, and Section 3: *Cover Crops* for more specifics.

Rotating crops that produce abundant organic matter, such as hay crop and grain-legume cover crops, with ones that produce less, such as vegetables, will help to sustain organic matter levels and promote good soil tilth (see Section 2: *Soil Health* and Section 8: *Crop and Soil Nutrient Management*). Cucurbits generally have a medium nutrient requirement (Table 4.2.1). Growing a cover crop, preferably one that includes a legume (unless the field has a history of *Pythium* problems), prior to or after a cucurbit crop, will help to renew soil nutrients, improve soil structure, and diversify soil organisms. Deep-rooted crops in the rotation to help break up compacted soil layers.

Table 4.2.1 Crops Nutrient Requirements

Crop	Nutrient Needs		
	Lower	Medium	Higher
	bean	cucumber	broccoli
	beet	eggplant	cabbage
	carrot	brassica greens	cauliflower
	herbs	pepper	corn
	pea	pumpkin	lettuce
	radish	spinach	potato
		chard	tomato
		squash	
		winter squash	

From NRAES publication [Crop Rotation on Organic Farms: A Planning Manual](#). Charles L. Mohler and Sue Ellen Johnson, editors, (Link 18).

Crop Information Specific to Cucurbits

Plan at least three years between cucurbit family plantings and peppers, eggplants, tomatoes or other cucurbits. Crucifers would be an especially good crop to precede cucurbits.

Table 4.2.2 Potential Interactions of Crops Grown in Rotation with Cucurbits

Crops in Rotation	Potential Rotation Effects	Comments
Many crops	Decrease weeds	Mulched vine crops help reduce weed populations for subsequent crops. Mulched cucurbits are a good choice prior to growing crops where weed control is challenging.
Carrot, lettuce, spinach and other direct seeded crops.	Increase weeds in direct seeded crops	Unmulched vine crops are often very weedy. Do not follow with direct seeded crops such as carrot, parsnip, lettuce, or spinach.
Eggplant, pepper	Increase <i>Phytophthora capsici</i>	<i>Phytophthora capsici</i> causes collar rot of eggplant and Phytophthora blight in cucurbits and peppers. Use a rotation of more than 3 years between these crops. Also found on weeds: common purslane, eastern black nightshade, horsenettle, velvetleaf, field pepperweed, field pennycress, Virginia pepperweed.
Broccoli, cauliflower, Brussels sprouts, kale, cabbage, collards, radish, rutabaga, turnip, daikon	Decrease clubroot	Clubroot declines more quickly when grown in rotation with cucurbits, tomato, snap bean or buckwheat.
Corn	Increase corn rootworm	Corn rootworm adults are attracted to cucurbits. They lay their eggs at the base of the plants and the larvae attack corn roots the following year.
Lettuce, spinach, brassica greens	Possible double cropping	Cucurbits can be double cropped when planted after early salad crops or brassica greens.
Hairy vetch	Early seeding of cover crop	Hairy vetch can be overseeded into winter squash in July to provide a winter cover crop after harvest.

Excerpt from Appendix 2 of [Crop Rotation on Organic Farms: A Planning Manual](#). Charles L. Mohler and Sue Ellen Johnson, editors. (Link 18)

4.3 Pest History

Knowledge about the pest history for each field is important for planning a successful cropping strategy. Germination may be reduced in fields with a history of *Pythium* or *Rhizoctonia*. Avoid fields that contain heavy infestations of perennial weeds such as nutsedge, bindweed, and quackgrass as these weeds are particularly difficult to control. One or more years focusing on weed population reduction using cultivated fallow and cover cropping may be needed before organic crops can be successfully grown in those fields. Susceptible crops should not be grown in fields with a history of *Sclerotinia* white mold without a rotation of several years to sweet corn or grain crops. Treat with Contans WG™ to reduce fungal sclerotia in the soil immediately after an infected crop is harvested.

All cultivated cucurbits are hosts for both root-knot nematode, *Meloidogyne hapla*, and root-lesion nematode, *Pratylenchus penetrans*. It is important to know whether or not these nematodes are present in the field in order to develop long-term crop rotations and cropping sequences that either reduce the populations in heavily infested fields or minimize their increase in fields that have no to low infestation levels. Refer to Section 11.2 for more information on nematodes.

4.4 Soil and Air Drainage

Cucurbits need well drained soil types to reduce the risk of *Phytophthora blight*.

With the exception of powdery mildew, most fungal and bacterial pathogens need free water on the plant tissue or high humidity for several hours in order to infect. Any practice that promotes leaf drying or drainage of excess water from the root zone will minimize favorable conditions for infection and disease development. Fields with poor air movement, such as those surrounded by hedgerows or woods, create an environment that favors prolonged leaf wetness. Plant rows parallel to the prevailing winds, which is typically in an east-west direction, and avoid overcrowding to promote drying of the soil and reduce moisture in the plant canopy.

5. WEED MANAGEMENT

Weed management can be one of the biggest challenges on organic farms, especially during the transition and the first several years of organic production. To be successful, use an integrated approach to weed management that includes crop rotation, cover cropping, cultivation, and planting design, based on an understanding of the biology and ecology of dominant weed species. A multi-year approach that includes strategies for controlling problem weed species in a sequence of crops will generally be more successful than attempting to manage each year’s weeds as they appear. Relying on cultivation alone to manage weeds in an organic system is a recipe for disaster.

Management plans should focus on the most challenging and potentially yield-limiting weed species in each field. Be

sure, however, to emphasize options that do not increase other species that are present. Alternating between early and late-planted crops, and short and long season crops in the rotation can help minimize buildup of a particular weed or group of weeds with similar life cycles or growth habits, and will also provide windows for a variety of cover crops.

5.1 Record Keeping

Scout and develop a written inventory of weed species and their severity for each field. Accurate identification of weeds is essential. Weed fact sheets provide a good color reference for common weed identification. See Penn State University *Weed Identification* book (Reference 20), or Cornell [weed ecology](#) and Rutgers [weed gallery](#) websites (Links 29-30).

5.2 Weed Management Methods

Planting and cultivation equipment should be set up on the same number of rows to minimize crop losses and damage to crop roots during cultivation. It may be necessary to purchase specialized equipment to successfully control weeds in some crops. See resources at the end of this section to help fine-tune your weed management system.

Weeds in cucurbits are difficult to control after the crop vines out in the row, because tractor cultivation becomes impossible. A high percentage of weeds will then go to seed and carry over the weed problem to the following year. Transplanting cucurbits rather than direct seeding allows the canopy to close quicker and can reduce in-row weed development.

Planting cucurbits into black plastic mulch is another strategy to improve weed control, since the mulch prevents weed germination in the area immediately near the crop. Cultivate the aisles between plastic covered beds with sweeps. To avoid weed problems along the edges of the plastic, either use vegetable knives to under cut the margin of the plastic or use hilling discs or spider gangs to throw additional soil onto the edge of the plastic to bury weeds. These cultivations will be most effective when weeds are small.

6. RECOMMENDED VARIETIES

Variety selection is important both for the horticultural characteristics specified by the processor and the pest resistance profile that will be the foundation of a pest management program. If disease pressures are known, tables 6.1 and 6.2 can help to determine which varieties will be more successful in reducing disease problems. Collaborate with processors on varieties, choosing those with some level of disease resistance if possible.

A certified organic farmer is required to plant certified organic seed. If, after contacting at least three suppliers, organic seed is not available for a particular variety, then the certifier may allow untreated conventional seed to be used.

Straw mulch is an alternative to black plastic, but will cool the soil and slow crop development. Straw can also be used for weed suppression between plastic covered beds. Rodents may nest in the straw, however, and then feed on the fruit. Also, belly rot may be more prevalent in straw mulch. If using straw without plastic, tine weed and cultivate direct seeded crops as indicated below, then lay straw shortly before vines run out. For effective weed control lay 3 inches of baled compressed material or 6 inches of loose straw, which can be blown through a hydro-seeding cannon or bale chopper.

If direct seeding without black plastic, tine weed just before emergence and again 5 to 7 days after emergence. A third tine weeding may be possible a week later. Set the weeder to work about 2/3 of the seeding depth. When tine weeding cucurbits, avoid using weeders with > 45 degree bends in the tines.

Alternatively, cucurbits can be direct seeded or transplanted in a grid pattern, with equal spacing in and between rows. This allows cultivation in both directions. See Section 7: Planting Methods for spacing recommendations. In either case, cultivate at 10 to 14-day intervals for as long as possible. Once winter squash is well established, throw soil around the base of the plants to bury small weeds. Hand hoe before the vines run out of the row. Do the last cultivation with vegetable knives pointed *toward* the crop, which will allow you to reach in under the leaves and cultivate later and closer to the row.

Butternut squash is reasonably tolerant of weed competition.

Resources

[Steel in the Field](#) by Greg Bowman (Link 28).

[Cornell Weed Ecology website](#) (Link 29).

[Rutgers University, New Jersey Weed Gallery](#) (Link 30)

[University of Vermont videos on cultivation and cover cropping](#) (Link 31).

[ATTRA Principles of Sustainable Weed Management for Croplands](#) (Link 32).

[New Cultivation Tools for Mechanical Weed Control in Vegetables](#) (Link 33)

ORGANIC CUCUMBER & BUTTERNUT SQUASH PRODUCTION

Table 6.1 Disease Resistance of Pickling Cucumber Varieties for Processing

	Angular Leaf Spot	Anthraxnose	Bacterial Wilt	Downy Mildew	Powdery Mildew	Scab	Cucumber Mosaic Virus	Papaya Ringspot Virus	Watermelon Mosaic Virus	Zucchini Yellow Mosaic Virus
Alibi				X	X					
Amour					X					
Ballerina					X	X	X			
Bush Pickle						X	X			
Calypso F1	X	X		X	X	X	X			
Carolina F1	X	X		X	X	X	X	X	X	
Classy	H				X					
Cross Country	X	X		X	X	X	X			
County Fair	X		X							
Earlipik 14						M	M			
Eclipse	X	X		X	X	X	X			
Eureka	H	H		H	H	H	H	X	X	X
Fancy Pak M	X	X		X	X	X	X			
Fiesty					X					
FM 5020					X					
Jackson Classic F1	X	X		X	X	X	X			
Jackson Supreme	X	X		M	X	X	X			
H-19 Little Leaf					X					
Lafayette Classic F1	X	X		X	X	X	X			
Moxie					X					
Napoleon classic F1	X	X		X	X	X	X			
Patton					X					
Pioneer	X	X		X	X		X			
Salty				X	X	X	X			
Sassy	X	X		H	X	X	X	X		
SMR58					X	X				
Spear It					X					
Spunky					X					
Timor					X					
Vlasstar F1	X	X		X	X	X	X			
Wellington F1	X	X		X			X			
Wisconsin SMR						X				
Zapata	X	X		H	X	X	X	X	X	X

L-low resistance, M-medium resistance, H-high resistance X- variety has some level of resistance based on seed catalog information.

ORGANIC CUCUMBER AND BUTTERNUT SQUASH PRODUCTION

Table 6.2 Powdery Mildew Resistance in Butternut-type Winter Squash Varieties

Variety	Relative Maturity	Plant Type	Fruit Color	Fruit Size	Disease Resistance
Achieve	90 days	Large Bush	Lt Tan	4-6 lbs	PMR
Argonaut	140 days	Vigorous Vine	Orange	30 lbs	None
Atlas	90 days	Short Vine	Lt Tan	10-12"	None
Avalon	88 days	Vigorous Vine	Buff	5"x11"	None
Betternut 401	80 days	Semi-Bush	Lt Tan	8-9"; 3 lb	PMR
Bugle	80 days	Semi-Bush	Lt Tan	10"	PMR
Butternut Supreme	80 days	Semi-Bush	Lt Tan	10-12"	None
Casius	110 days	Vine	Lt Tan	14-15"	None
Early Butternut	85 days	Semi-Bush	Tan	8"	None
JWS 6823	100 day	Vine	Orange	3-4 lbs	PMR
Metro	105 days	Vine	Orange	2.5-3.5 lbs	PMR
Matilda	110 days	Vine	Lt Tan	7-9 lbs	None
Neck Pumpkin	120 days	Vine	Lt Brown	18-24"	None
Pilgrim	80 days	Semi-Bush	Lt Tan	8-10"	None
Provider	100 day	Large Bush	Lt Tan	6-12 lbs	PMR
Ultra	90 days	Vine	Lt Tan	15"	None
Waltham	97 days	Vine	Lt Tan	10-12"	Plectosporium

PMR = Powdery Mildew Resistance

Table 6.3 Ranking of Butternut Varieties by Cucumber Beetle Preference

Variety	Ranking
Zenith	13
Butternut Supreme	16
Early Butternut	25
Waltham	28

Ranking 1-14- non-preferred, > 45 – highly preferred.

7. PLANTING METHODS

7.1 Cucumber

Direct seeded cucumbers are planted May 25th to July 15th. Wait 2 to 3 weeks depending on soil temperature and moisture between plowing down a cover crop and planting direct seeded cucurbits so that the cover crop has sufficient time to decompose to avoid allelopathy and seedcorn maggot.

If a processing grower wanted to experiment with transplants, in upstate New York, they are typically set in the field between June 1st and 10th for harvest in mid-August to early September. Using transplants requires careful timing to avoid allowing the plants to become root-bound in the transplant flats.

Wind, combined with low air temperatures (32° to 50°F), can severely damage vine crops, retarding maturity and reducing yields. Soil temperatures below 50°F also slow growth and impair water uptake by roots. For these reasons, plastic mulch

and row covers are often used. Black, clear, or infrared-transmitting (IRT) mulches can be used.

Another means of wind protection is to plant rye strips between every second or third row of the crop. Site selection is also important for wind protection and optimal soil temperature. Light-textured soils that warm quickly in the spring are preferable to heavier soils that remain cool. Good drainage, fertility, and high organic matter are other soil features that will improve the potential for good yield and quality.

7.2 Winter squash

These are normally direct seeded after all danger of frost is past, between May 25th and June 15th. Winter squash also can be planted on a grid, with equal distance in and between rows, to allow cultivation both ways.

Table 7.1 Recommended spacing

Crop	Row	In-row
Cucumber-Pickles	2-5'	3-8"
Squash-Butternut	6-8'	24-48"

8. CROP & SOIL NUTRIENT MANAGEMENT

To produce a healthy crop, sufficient soluble nutrients must be available from the soil to meet the minimum requirements for the whole plant. The total nutrient needs of a crop are

much higher than just the nutrients that are removed from the field when that crop is harvested. All of the roots, stems, leaves and other plant parts require nutrients at specific times during plant growth and development. Restrictions in the supply of required plant nutrients will limit growth and reduce crop quality and yields.

The challenge in organic systems is balancing soil fertility to supply these required plant nutrients at a time and at sufficient levels to support healthy plant growth. Soil microbes decompose organic matter to release nutrients and convert organic matter to more stable forms such as humus. This breakdown of soil organic matter occurs throughout the growing season, depending on soil temperatures, water availability and soil quality. The released nutrients are then held on soil particles or humus making them available to crops or cover crops for plant growth. Amending soils with compost, cover crops, or crop residues also provides a food source for soil microorganisms and when turned into the soil, starts the nutrient cycle again.

During the transition years and the early years of organic production, soil amendment with composts or animal manure can be a productive strategy for building organic matter, biological activity and soil nutrient levels. This practice of heavy compost or manure use is not, however, sustainable in the long-term. If composts and manures are applied in the amounts required to meet the nitrogen needs of the crop, phosphorous may be added at higher levels than required by most vegetable crops. This excess phosphorous will gradually build up to excessive levels, increasing risks of water pollution or invigorating weeds like purslane and pigweed. A more sustainable, long-term approach is to rely more on legume cover crops to supply most of the nitrogen needed by the crop and use grain or grass cover crops to capture excess nitrogen released from organic matter at the end of the season to minimize nitrogen losses to leaching. See Section 3: *Cover Crops*. When these cover crops are incorporated into the soil, their nitrogen, as well as carbon, feeds soil microorganisms, supporting the nutrient cycle. Harvesting alfalfa hay from the field for several years can reduce high phosphorus and potassium levels.

Some soils are naturally high in P and K, or have a history of manure applications that have resulted in elevated levels. Regular soil testing helps monitor nutrient levels, in particular phosphorus (P) and potassium (K). Choose a reputable soil-testing lab (Table 8.0.1) and use it consistently to avoid discrepancies caused by different soil extraction methods. Maintaining a soil pH between 6.3 and 6.8 will maximize the availability of all nutrients to plants.

To assess overall impact of organic matter additions on soil health, consider selecting a few target or problem fields for soil health monitoring over time via the [Cornell Standard Soil Health Analysis Package](#). This suite of eight tests complements a standard soil chemical nutrient analysis by focusing on biological and physical soil health indicators. While the test results will provide feedback on how the soil sample compares to other New York soils, the real power is in the baseline readings for comparison in the future after implementing new soil health and nutrient management strategies.

Table 8.0.1 Nutrient Testing Laboratories.

TESTING LABORATORY	SOIL	COMPOST/ MANURE	REFERENCES
The Agro One Lab (Cornell Recommendations)	x	x	23
Agri Analysis, Inc.		x	20
A&L Eastern Ag Laboratories, Inc.	x	x	21
Cornell Soil Nutrient Analysis Lab	x		19
Penn State Ag Analytical Services Lab	x	x	22
University of Massachusetts	x	x	24
University of Maine	x	x	25

8.1 Fertility

Recommendations from the [Cornell Integrated Crop and Pest Management Guidelines](#) (Link 1) indicate a cucurbit crop requires 100 lb. of available nitrogen (N), 120 lb. of phosphorus (P), and 120 lb of potassium (K) per acre. These levels are based on the total needs of the whole plant and assume the use of synthetic fertilizers. Farmer and research experience suggests that lower levels may be adequate in organic systems. See Table 8.2.2 for the recommended rates of P and K based on soil test results. Nitrogen is not included because levels of available N change in response to soil temperature and moisture, N mineralization potential, and leaching. As many of the nutrients as possible should come from cover crop, manure, and compost additions in previous seasons.

If the crop is grown with plastic mulch, the nitrogen level can be reduced to 70 lb. of available N. The more uniform moisture and warmer temperatures under plastic mulch increase the decomposition rate of soil organic matter, which increases available N.

Develop a plan for estimating the amount of nutrients that will be released from soil organic matter, cover crops, compost, and manure. A strategy for doing this is outlined in Section

8.2: *Preparing an Organic Nutrient Budget.* It is important to remember that in cool soils, microorganisms are less active, and nutrient release may be too slow to meet the crop needs. Once the soil warms, nutrient release may exceed crop needs. In a long-term organic nutrient management approach, most of the required crop nutrients would be in place as organic matter before the growing season starts. Nutrients required by the crop in the early season can be supplemented by highly soluble organic amendments such as poultry manure composts or organically approved bagged fertilizer products (see Tables 8.2.4 to 8.2.6). These products can be expensive so are most efficiently used if banded at planting. The National Organic Standards Board states that no more than 20% of total N can be applied as Chilean nitrate. Be sure to confirm that the products you select are approved for use in organic by your certifier prior to field application.

8.2 Preparing an Organic Nutrient Budget

Insuring an adequate supply of nutrients when the crop needs them requires careful planning. Developing an organic nitrogen budget can help estimate the amount of nutrients released by various organic amendments as well as native soil organic matter. Table 8.2.3 estimates common nutrient content in animal manures; however actual compost and manure nutrient content should be tested just prior to application. Analysis of other amendments, as well as cover crops, can be estimated using published values (see Tables 8.2.4 to 8.2.6 and 3.1 for examples). Keeping records of these nutrient inputs and subsequent crop performance will help evaluate if the plan is providing adequate fertility during the season to meet production goals.

Remember that with a long-term approach to organic soil fertility, the N mineralization rates of the soil will increase. This means that more N will be available from organic amendments because of increased soil microbial activity and diversity. Feeding these organisms different types of organic matter is essential to building this type of diverse biological community and ensuring long-term organic soil and crop productivity. Consider submitting soil samples for a Cornell Soil Health Test (Reference 13). This test includes an estimate of nitrogen mineralization rate, which indicates the potential for release of N from soil organic matter. Testing soils over time can be useful for monitoring changes in nitrogen mineralization rate during the transition, and over time, in organic production.

Estimating total nutrient release from the soil and comparing it with soil test results and recommendations requires record-keeping and some simple calculations. Table 8.2.1 below can be used as a worksheet for calculating nutrients supplied by the soil compared to the total crop needs.

Table 8.2.1 Calculating Nutrient Credits and Needs.

	Nitrogen (N) lbs/acre	Phosphate (P ₂ O ₅) lbs/acre	Potash (K ₂ O) lbs/A
1. Total crop nutrient needs			
2. Recommendations based on soil test			
3. Credits			
a. Soil organic matter		---	---
b. Manure			
b. Compost			
c. Prior cover crop			
4. Total credits:			
5. Additional needed (2-4) =			

Line 1. Total Crop Nutrient Needs: Research indicates that an average cucurbit crop requires 100 lbs. of available nitrogen (N), 120 lbs. of phosphorus (P), and 120 lbs. of potassium (K) per acre to support a medium to high yield (see section 8.1: *Fertility* above).

Line 2. Recommendations Based on Soil Test: Use Table 8.2.2 to determine the amount of P and K needed based on soil test results.

Table 8.2.2 Recommended Amounts of Phosphorus and Potassium for Cucurbits Based on Soil Tests

	Soil Phosphorus Level			Soil Potassium Level		
	low	med	high	low	med	high
Level shown in soil test	P ₂ O ₅ lbs/A			K ₂ O lbs/A		
Total nutrient recommendation	120	80	40	120	80	40

Line 3a. Soil Organic Matter: Using the values from your soil test, estimate that 20 lbs. of nitrogen will be released from each percent organic matter in the soil.

Line 3b. Manure: Assume that manure will release N for 3 years. Based on the test of total N in the manure applied, estimate that 50% is available in the first year, and then 50% of the remaining is released in each of the next two years. So, for an application rate of 100 lbs. of N as manure, in year one 50 lbs. would be available, 25 lbs. in year 2, and 12.5 lbs. in year 3. Remember to check with your certifier on the days-to-harvest interval when using raw manure and allow a minimum of 120 days between application and harvesting. Enter estimated phosphorous additions and be aware that some manures have high phosphorous content (Table 8.2.3). Assume about 80% of the phosphorous and 90% of the potassium to be available in the first year

Line 3c. Compost: Estimate that 10 to 25% of the N, 80% of the phosphorous and 90% of the potassium contained in compost will be available the first year. Compost maturity

ORGANIC CUCUMBER AND BUTTERNUT SQUASH PRODUCTION

will influence how much N is available. It is important to test each new mix of compost for actual amounts of the different nutrients available. If the material is immature, more of the N may be available to the crop in the first year. A word of caution: Using compost to provide for a crop's nutrient needs is not generally a financially viable strategy. The total volume needed can be very expensive for the units of N available to the crop. Most stable composts should be considered as soil conditioners, improving soil health, microbial diversity, tilth, and nutrient retaining capacity. Also keep in mind that manure-based composts are potentially high in salts that could become a problem if used yearly. Most compost analyses include a measure of electrical conductivity which indicates level of salts present in the finished product. Any compost applied on organic farms must be approved for use by your farm certifier. Compost generated on the farm must follow an approved process outlined by your certifier.

Line 3d. Cover Crops: Estimate that 50 percent of the fixed N is released for plant uptake during the season it is incorporated.. Consult Table 3.1 to estimate the amount of N fixed by legume cover crops.

Line 4. Total Credits: Add together the various nutrient values from the organic matter, compost and cover crops to estimate the nutrient supplying potential of the soil (see example below). There is no guarantee that these amounts will actually be available in the season, since soil temperatures, water, and crop physiology all impact the release and uptake of these soil nutrients. If the available N does not equal the minimum requirement for this crop (~90 lbs/acre), a sidedress application of organic N may be needed. There are several sources for N for organic sidedressing (see Table 8.2.4) as well as pelleted composts. If early in the organic transition, a grower may consider increasing the N budget supply by up to 25%, to help reduce some of the risk of N being limiting to the crop.

Table 8.2.3 includes general estimates of nutrient availability for manures and composts but these can vary widely depending on animal feed, management of grazing, the age of the manure, amount and type of bedding, and many other factors. See table 3.1 for estimates of the nitrogen content of various cover crops. **Manure applications may not be allowed by your certifier or marketer even if applied 120 days before harvest. Check with both these sources prior to making manure applications.**

Table 8.2.3 Nutrient Content of Common Animal Manures and Manure Composts

	TOTAL N	P ₂ O ₅	K ₂ O	N1 ¹	N2 ²	P ₂ O ₅	K ₂ O
	NUTRIENT CONTENT LB/TON			AVAILABLE NUTRIENTS LB/TON IN FIRST SEASON			
Dairy (with bedding)	9	4	10	6	2	3	9
Horse (with bedding)	14	4	14	6	3	3	13
Poultry (with litter)	56	45	34	45	16	36	31
Composted dairy manure	12	12	26	3	2	10	23
Composted poultry manure	17	39	23	6	5	31	21
Pelleted poultry manure ³	80	104	48	40	40	83	43
Swine (no bedding)	10	9	8	8	3	7	7
	NUTRIENT CONTENT LB/1000 GAL.			AVAILABLE NUTRIENTS LB/1000 GAL FIRST SEASON			
Swine finishing (liquid)	50	55	25	25 ^a	20 ^b	44	23
Dairy (liquid)	28	13	25	14 ^a	11 ^b	10	23

1-N1 is an estimate of the total N available for plant uptake when manure is incorporated within 12 hours of application, 2-N2 is an estimate of the total N available for plant uptake when manure is incorporated after 7 days. 3 –Pelletized poultry manure compost. (Available in New York from Kreher's.)
A injected, b incorporated.

Adapted from "[Using Manure and Compost as Nutrient Sources for Fruit and Vegetable Crops](#)" by Carl Rosen and Peter Bierman (Link 26) and Penn State Agronomy Guide 2007-8 (Link 27).

ORGANIC CUCUMBER & BUTTERNUT SQUASH PRODUCTION

Tables 8.2.4 to 8.2.6 lists some commonly available fertilizers, their nutrient content.

Table 8.2.4 Available Nitrogen in Organic Fertilizer

Sources	Pounds of Fertilizer/Acre to Provide X Pounds of N per Acre				
	20	40	60	80	100
Blood meal, 13% N	150	310	460	620	770
Soy meal 6% N (x 1.5) ^a also contains 2% P and 3% K ₂ O	500	1000	1500	2000	2500
Fish meal 9% N, also contains 6% P ₂ O ₅	220	440	670	890	1100
Alfalfa meal 2.5% N also contains 2% P and 2% K ₂ O	800	1600	2400	3200	4000
Feather meal, 15% N (x 1.5) ^a	200	400	600	800	1000
Chilean nitrate 16% N cannot exceed 20% of crop's need.	125	250	375	500	625

^a Application rates for some materials are multiplied to adjust for their slow to very slow release rates. Adapted by Vern Grubinger from the University of Maine soil testing lab (Link 25).

Table 8.2.5 Available Phosphorous in Organic Fertilizers.

Sources	POUNDS OF FERTILIZER/ACRE TO PROVIDE X POUNDS OF P ₂ O ₅ PER ACRE				
	20	40	60	80	100
Bonemeal 15% P ₂ O ₅	130	270	400	530	670
Rock Phosphate 30% total P ₂ O ₅ (x4) ^a	270	530	800	1100	1300
Fish meal, 6% P ₂ O ₅ (also contains 9% N)	330	670	1000	1330	1670

^a Application rates for some materials are multiplied to adjust for their slow to very slow release rates. Adapted by Vern Grubinger from the University of Maine soil testing lab (Link 25).

Table 8.6 Available Potassium in Organic Fertilizers.

Sources	POUNDS OF FERTILIZER/ACRE TO PROVIDE X POUNDS OF K ₂ O PER ACRE:				
	20	40	60	80	100
Sul-Po-Mag 22% K ₂ O also contains 11% Mg	90	180	270	360	450
Wood ash (dry, fine, grey) 5% K ₂ O, also raises pH	400	800	1200	1600	2000
Alfalfa meal 2% K ₂ O also contains 2.5% N	1000	2000	3000	4000	5000
Greensand or Granite dust 1% K ₂ O (x 4) ^a	8000	16000	24000	32000	40000
Potassium sulfate 50% K ₂ O	40	80	120	160	200

^a Application rates for some materials are multiplied to adjust for their slow to very slow release rates. Tables 8.4 to 8.6 adapted by Vern Grubinger from the University of Maine soil testing lab (Link 25).

An example of how to determine nutrient needs for cucurbits.

You will be growing an acre of winter squash. The Cornell Integrated Crop and Pest Management Guidelines suggests a total nutrient need for a cucurbit crop is 100 lb. N, 120 lb. P, and 120 lb K per acre for a high yielding crop. Soil tests show a pH of 6.5, with medium P and low K levels and recommends 80 lbs P₂O₅/acre and 120 lbs K₂O/acre (see Table 8.2.3). The field you'll be planting has 2% organic matter and there is a stand of red clover that will be turned in a week or so prior to planting (see Table 3.1). Last season you injected 1000 gallons of liquid hog manure into the red clover stubble after taking the last cutting of hay.

Table 8.2.7 Example: Calculating Nutrient Credits and Needs Based on Soil Sample Recommendations.

	Nitrogen (N) lbs/A	Phosphate (P ₂ O ₅) lbs/A	Potash (K ₂ O) lbs/acre
1. Total crop nutrient needs:	100	120	120
2. Recommendations based on soil test	# not provided	80	120
3. Credits			
a. Soil organic matter 2%	40	---	---
b. Manure – 1000 gal hog	25	44	23
c. Compost - none	0	0	0
d. Cover crop – red clover	50	0	0
4. Total credits:	115	44	23
5. Additional needed (2-4) =	0	36	97

Table 8.2.3 indicates about 25 lbs. N will be released in the first season from 1000 gallons of hog manure injected. Estimate that each percent organic matter will release about 20 lbs. of N, so the 2% soil organic matter will supply 40 lbs. N (line 3a). Looking at Table 3.1, the red clover cover crop will release about half its fixed N, or 50 lbs. as it decomposes (line 3d), for a total estimated N released and available for plant uptake of 115 lbs. per acre. The 44 lbs. of P released from the injected manure will need to be supplemented by an additional 40 lbs P through applying ~250 lbs/A of bonemeal to meet the soil test recommendation of 80 lbs per acre. Potassium will also need to be supplemented in this example. The manure supplies 23 of the 120 lbs. needed. The remaining ~100 lbs. K₂O/acre, can be incorporated through broadcasting 200 lbs. of potassium sulfate from an organically approved product, if soil tests indicate sufficient magnesium. If magnesium is needed, then apply ~450 lbs. of Sul-Po-Mag.

Additional Resources

[Determining Nutrient Applications for Organic Vegetables \(reference 27b\)](#)

9. HARVESTING

9.1 Cucumber

Pickling cucumbers in smaller plantings are picked by hand on four to five day intervals depending on temperature and moisture. A field can be picked 7 or 8 times, although 3 to 5 times is more typical.

Populations of 40,000 plants or more per acre concentrate yields sufficiently for mechanical harvesting of pickles. Success of machine harvest depends on establishing a uniform stand, harvesting when ten percent of the fruit are two inches in diameter or larger, and moving the fruit quickly from the field to the processing plant. Not all processors allow machine harvesting.

9.2 Winter Squash

Store only mature fruit that is free of disease. Harvest and place the fruit under shelter before chilling or freezing can damage it. Fruits subjected to temperatures below 50°F for two weeks or more may break down and rot.

Desirable storage conditions are 50° to 55°F at a relative humidity of 50 to 75 percent with good air circulation to maintain uniform temperature and humidity throughout the storage period. During a long storage period, fruit will lose less moisture if humidity is maintained near 70 to 75 percent.

10. USING ORGANIC PESTICIDES

Given the high cost of many pesticides and the limited amount of efficacy data from replicated trials with organic products, the importance of developing an effective system of cultural practices for insect and disease management cannot be emphasized strongly enough. **Pesticides should not be relied on as a primary method of pest control.** Scouting and forecasting are important for detecting symptoms of diseases at an early stage. When conditions do warrant an application, proper choice of materials, proper timing, and excellent spray coverage are essential.

10.1 Sprayer Calibration and Application

Calibrating sprayers is especially critical when using organic pesticides since their effectiveness is sometimes limited. For this reason, they tend to require the best spraying conditions to be effective. Read the label carefully to be familiar with the unique requirements of some products, especially those with live biological organisms as their active ingredient (e.g. Contans WG). The active ingredients of some biological pesticides (e.g. Serenade) are actually metabolic byproducts of the organism. Calculating nozzle discharge and travel speed

are two key components required for applying an accurate pesticide dose per acre. Applying too much pesticide is illegal, can be unsafe and is costly whereas applying too little can fail to control pests or lead to pesticide resistance.

RESOURCES:

<https://ipmguidelines.org/> (Link 71).

[Calibrating Backpack Sprayers](#) (Link 72).

[Pesticide Environmental Stewardship: Calibration](#) (Link 73).

[Knapsack Sprayers – General Guidelines for Use](#) (Link 74)

[Herbicide Application Using a Knapsack Sprayer](#) (Link 75) (This publication is relevant for non-herbicide applications).

[Pesticide Environmental Stewardship, Coop Extension](#) (Link 76)

[Pesticide Environmental Stewardship, CIPM](#) (Link 77)

[Vegetable Spraying](#) (Link 78)

10.2 Regulatory Considerations

Organic production focuses on cultural, biological, and mechanical techniques to manage pests on the farm, but in some cases pesticides, which include repellents, allowed for organic production are needed. Pesticides mentioned in this organic production guide are registered by the United States Environmental Protection Agency (EPA) or meet the EPA requirements for a “minimum risk” pesticide. At the time of publication, the pesticides mentioned in this guide meet the New York State Department of Environmental Conservation (NYS DEC) registration requirements for use in New York State. See Cornell’s [Product, Ingredient, and Manufacturer System](#) website (Link 2) for pesticides currently registered for use in NYS. Additional products may be available for use in other states.

To maintain organic certification, products applied must also comply with the National Organic Program (NOP) regulations as set forth in [7 CFR Part 205, sections 600-606](#) (Link 14). The [Organic Materials Review Institute](#) (OMRI) (Link 6) is one organization that reviews products for compliance with the NOP regulations and publishes lists of compliant products, but other entities also make product assessments. Organic growers are not required to use only OMRI listed materials, but the list is a good starting point when searching for allowed pesticides.

Finally, farms grossing more than \$5,000 per year and labeling products as organic must be certified by a NOP accredited certifier who must approve any material applied for pest management. ALWAYS check with the certifier before applying any pest control products. Some certifiers will review products for NOP compliance.

Note that "home remedies" may not be used. Home remedies are products that may have properties that reduce the impact of pests. Examples of home remedies include the use of beer

as bait to reduce slug damage in strawberries or dish detergent to reduce aphids on plants. These materials are not regulated as pesticides, are not exempt from registration, and are therefore not legal to use.

Do you need to be a certified pesticide applicator?

The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) defines two categories of pesticides: general-use and restricted use. NYS DEC also defines additional restricted-use pesticides. Pesticide applicator certification is required to purchase and use restricted-use pesticides. Restricted-use pesticides mentioned in this guide are marked with an asterisk (*). Farmers who purchase and use only general-use pesticides on property they own or rent do not need to be certified pesticide applicators. However, we do encourage anyone who applies pesticides to become certified.

Worker Protection Standard training. If the farm has employees who will be working in fields treated with a pesticide, they must be trained as workers or handlers as required by the federal Worker Protection Standard (WPS). Having a pesticide applicator certification is one of the qualifications needed to be a WPS trainer. Certified pesticide applicators meet the WPS training requirements. For more information on the Worker Protection Standard see: [How To Comply with the Worker Protection Standard](#) (Link 14a). See [Revisions To the Worker Protection Standard](#) for a summary of new worker protection standards that will take effect January 2017 (Link 14d). Find more information on pesticide applicator certification from the list of [State Pesticide Regulatory Agencies](#) (Link 14b) or, in New York State, see the Cornell Pesticide Management Education Program website at <http://psep.cce.cornell.edu> (Link 14c).

10.3 Pollinator Protection

Honey bees, wild bees, and other insects are important for proper pollination of many crops. Poor pollination results in small or odd-shaped fruit as well as low yields.

To avoid harming bees with insecticides, remember these general points:

- Always read the label before use.
- Do not spray blooming crops;
- Mow blooming weeds before treatment or spray when the blossoms are closed;
- Avoid application during the time of day when bees are most numerous; and
- Make application in the early morning or evening.

If pesticides that are highly toxic to bees are used in strict accordance with label directions, little or no harm should be done to bees. Label statements on pesticides that are highly toxic to honey bees may carry a caution statement such as: “This product is highly toxic to bees exposed to direct treatment or residues on blooming crops or weeds. Do not apply this product or allow it to drift to blooming crops or weeds if bees are visiting the treatment area.”

In early 2015 the EPA proposed new pollinator protection label language to protect managed bees under contract pollination services. The intent of this new language is to protect bees from contact exposure to pesticides that are acutely toxic to bees. Once the new language is finalized, pesticide labels will include the new wording and requirements. As part of this proposal, EPA identified certain active ingredients that are acutely toxic to bees. Active ingredients mentioned in this publication meeting this criteria are noted with a bee symbol (♻️).

For more information on pollinator protection, visit www.epa.gov/opp00001/ecosystem/pollinator/index.html and pesticidestewardship.org/PollinatorProtection/Pages/default.aspx

10.4 Optimizing Pesticide Effectiveness

Information on the effectiveness of a particular pesticide against a given pest can sometimes be difficult to find. Some university researchers include pesticides approved for organic production in their trials; some manufacturers provide trial results on their web sites; some farmers have conducted trials on their own. Efficacy ratings for pesticides listed in this guide were summarized from university trials and are only provided for some products. The [Resource Guide for Organic Insect and Disease Management](#) (Link 5) provides efficacy information for many approved materials.

In general, pesticides allowed for organic production may kill a smaller percentage of the pest population, could have a shorter residual, and may be quickly broken down in the environment. Microbial-based products often have a shorter shelf life than other products, so be sure to use them by the expiration date. Read the pesticide label carefully to determine if water pH or hardness will negatively impact the pesticide’s effectiveness. Use of a surfactant may improve organic pesticide performance. OMRI lists [adjuvants](#) on their website (Link 6). Regular scouting and accurate pest identification are essential for effective pest management. Thresholds used for conventional production may not be useful for organic systems because of the typically lower percent mortality and shorter residual of pesticides allowed for organic production.

When pesticides are needed, it is important to target the most vulnerable stages of the pest. The use of pheromone traps or other monitoring or prediction techniques can provide an early warning for pest problems, and help effectively focus scouting efforts. When using pesticides, be sure you have sufficient coverage to provide adequate control. Consult the pesticide label for guidance.

11. DISEASE MANAGEMENT

In organic systems, cultural practices form the basis of a disease management program. Promote plant health by maintaining a biologically active, well-structured, adequately drained and aerated soil that supplies the requisite amount and balance of nutrients. Choose varieties resistant to one or more important diseases whenever possible (see Section 6: *Varieties*). Plant only clean, disease-free seed and transplants and maintain the best growing conditions possible.

Rotation is an important management practice for pathogens that overwinter in crop debris. Rotating between crop families is useful for many diseases, but may not be effective for pathogens with a wide host range, such as *Sclerotinia* white mold and *Phytophthora* blight, or pathogens which do not overwinter in New York, such as downy and powdery mildew. Rotation with a grain crop, preferably a crop or crops that will be in place for one or more seasons, deprives disease-causing organisms of a host, and also contributes to a healthy soil structure that promotes vigorous plant growth. The same practices are effective for preventing the buildup of root damaging nematodes in the soil, but keep in mind that certain grain crops are also hosts for some nematode species. See more on crop rotation in Section 4.2: *Crop Rotation Plan*.

Other important cultural practices can be found under each individual disease listed below. Maximizing air movement and leaf drying is a common theme. Many plant diseases are favored by long periods of leaf wetness. Any practice that promotes faster leaf drying, such as orienting rows with the prevailing wind, or using a wider row or plant spacing, can slow disease development. Fields surrounded by trees or brush, that tend to hold moisture after rain, fog or dew, should be avoided if possible, especially for a crop like cucurbits, with a long list of potential disease problems.

Scouting fields weekly is key to early detection and evaluating control measures. The earlier a disease is detected, the more likely it can be suppressed with organic fungicides. When available, scouting protocols can be found in the sections listed below for each individual disease. The same scouting protocol may be used for angular leaf spot, anthracnose, scab, Septoria, and Ulocladium. While following a systematic scouting plan, keep watch for other disease

problems. Removing infected plants during scouting is possible on a small operation. Accurate identification of disease problems, especially recognizing whether they are caused by a bacterium or fungus, is essential for choosing an effective control strategy. Anticipate which diseases are likely to be problems that could affect yield and be ready to take control action as soon as symptoms are seen. Allowing pathogen populations to build can quickly lead to a situation where there are few or no options for control.

Table 11.1 Relative Susceptibility to Diseases in Cucurbit Crops.

Disease	Pickling Cucumber	Butternut Squash
Angular leaf spot	L, R	M
Bacterial leaf spot	L	M
Bacterial wilt	H	L
Alternaria leaf blight	L	L
Anthracnose	L, R	L
Choanephora blight	-	L
Fusarium crown and fruit rot	L	M
Fusarium wilt	-	-
Damping-off	M	L
Downy mildew	H, R	H
Gummy stem blight (Black rot)	L	M
Phytophthora blight	H	H
Powdery mildew	M, R	M, R
Plectosporium blight	L	L/M
Scab	L, R	L
Septoria leaf spot	-	L
Ulocladium leaf spot	M,R	-
Viruses	L, R	M

R = resistant varieties exist (plants are less susceptible); L = low (occurs, but rarely in damaging levels); M = moderate, H = high level of susceptibility to pest; - = disease tolerance for a particular crop is unknown.

All currently available fungicides allowed for organic production are protectants meaning they must be present on the plant surface before disease inoculum arrives to effectively prevent infection. They have no activity on pathogens once they are inside the plant. A few fungicides induce plant resistance and must be applied several days in advance of infection to be effective. Biological products must be handled carefully to keep the microbes alive. Follow label instructions carefully to achieve the best results.

Contact your local cooperative extension office to see if newsletters and pest management updates are available for your region. For example, in western New York, the [Cornell Vegetable Program](#) offers subscriptions to *VegEdge*, a report that gives timely information regarding crop development, pest activity and control. Enrollment in the [Eastern New York Commercial Horticulture Program](#) includes a subscription to *Produce Pages* and weekly seasonal newsletters for vegetables, tree fruit, grapes and small fruit. On Long Island, see the *Long Island Fruit and Vegetable Update*.

ORGANIC CUCUMBER & BUTTERNUT SQUASH PRODUCTION

Organic farms must comply with all other regulations regarding pesticide applications. See Section 10. Using Organic Pesticides for details. **ALWAYS check with your organic farm certifier when planning pesticide applications.**

Use weather-based disease forecasting programs when available to help time applications to periods of favorable weather or the arrival of inoculum. The movement of some pathogens that do not overwinter in the Northeast may be

tracked online to help determine when control measures are needed. Track [downy mildew](#) at the North American Plant Disease Forecast Center (Link 35).

Resources:

[Cornell Vegetable MD online](#) (Link 36).

[Resource Guide for Organic Insect and Disease Management](#) (Link 5)

Table 11.1 Calendar of When to Expect Diseases in the Northeast USA

Month	May	June	July	August	September	October
Weather Factors	Cool & wet Higher rainfall	Cool & wet Higher rainfall	Warm to hot Moderate rainfall	Warm & dry Moderate rainfall Morning dews	Warm to cool Moderate rainfall Long dews	Cool & wet
Septoria leaf spot						
Bacterial wilt						
Scab						
Powdery mildew						
Viruses						
Phytophthora blight						
Gummy stem/ Black rot						
Alternaria leaf blight						
Anthracoise						
Downy mildew						
Fusarium						

At the time this guide was produced, the following materials were available in New York State for managing this pest and were allowable for organic production. Listing a pest on a pesticide label does not assure the pesticide's effectiveness. The registration status of pesticides can and does change. Pesticides must be currently registered with the New York State Department of Environmental Conservation (DEC) to be used legally in NY. However, pesticides meeting the federal requirements for minimum-risk (25(b)) pesticides do not require registration. Current NY pesticide registrations can be checked on the Pesticide Product, Ingredient, and Manufacturer System [\(PIMS\) website](#) (Link 2). ALWAYS CHECK WITH YOUR CERTIFIER before using a new product.

Table 11.2 Pesticides Labeled for Organic Cucurbit Disease Management.

CLASS OF COMPOUND Product Name (active ingredient)	ALTERNARIA	ANGULAR LEAFSPOT	ANTHRACNOSE	BACTERIAL WILT	BELLY ROT	COTTONY LEAK	DAMPING OFF	DOWNY MILDEW	FUSARIUM	GUMMY STEM BLIGHT	PHYTOPHTHORA BLIGHT	POWDERY MILDEW	SCAB	SCLEROTINIA	SEED DECAY	SEPTORIA LEAF SPOT	ULOCLADIUM LEAF SPOT	VIRUSES
MICROBIALS																		
Actinovate AG (<i>Streptomyces lydicus</i> WYEC 108)	X		X		X	X	X	X	X		X	X		X	X			
Actinovate STP (<i>Streptomyces lydicus</i> WYEC 108)						X	X		X		X			X				
BIO-TAM (<i>Trichoderma asperellum</i> , <i>Trichoderma gamsii</i>)					X	X	X		X					X	X			
BIO-TAM 2.0 (<i>Trichoderma asperellum</i> , <i>Trichoderma gamsii</i>)					X	X	X				X			X				
Contans WG (<i>Coniothyrium minitans</i>)														X				
Defend DF (sulfur)												X						
Double Nickel 55 Biofungicide (<i>Bacillus amyloliquefaciens</i> str. D747)							X	X	X	X	X	X			X			

ORGANIC CUCUMBER & BUTTERNUT SQUASH PRODUCTION

Table 11.2 Pesticides Labeled for Organic Cucurbit Disease Management.

CLASS OF COMPOUND Product Name (active ingredient)	ALTERNARIA	ANGULAR LEAFSPOT	ANTHRACNOSE	BACTERIAL WILT	BELLY ROT	COTTONY LEAK	DAMPING OFF	DOWNY MILDEW	FUSARIUM	GUMMY STEM BLIGHT	PHYTOPHTHORA BLIGHT	POWDERY MILDEW	SCAB	SCLEROTINIA	SEED DECAY	SEPTORIA LEAF SPOT	ULOCLADIUM LEAF SPOT	VIRUSES
Double Nickel LC Biofungicide (<i>Bacillus amyloliquefaciens</i> str. D747)							X	X	X	X	X	X			X			
Mycostop Mix (<i>Streptomyces griseoviridis</i>)							X		X									
Mycostop Biofungicide(<i>Streptomyces griseoviridis</i>)							X		X									
Prestop Biofungicide WP (<i>Gliocladium catenulatum</i>)	X				X	X	X		X	X	X		X					
Regalia Biofungicide (<i>Reynoutria sachalinensis</i>)	X		X		X	X	X	X	X	X	X	X						
RootShield Granules (<i>Trichoderma harzianum</i> Rifai strain T-22)					X	X	X		X		X				X			
RootShield WP (<i>Trichoderma harzianum</i> Str. T-22 (KRL-AG2))					X	X	X		X		X				X			
RootShield PLUS+ WP (<i>Trichoderma harzianum</i> rifai str. T-22, <i>Trichoderma virens</i> str. G-41)					X	X	X		X		X				X			
RootShield PLUS+ Granules (<i>Trichoderma harzianum</i> str. T-22, <i>Trichoderma virens</i> str. G-41)					X	X	X		X		X				X			
Serenade MAX (<i>Bacillus subtilis</i> str QST 713)								X		X		X						
Serenade ASO (<i>Bacillus subtilis</i> str QST 713)								X		X		X						
Serenade Soil (<i>Bacillus subtilis</i> str. QST 713)					X	X	X		X		X				X			
Serifel (<i>Bacillus amyloliquefaciens</i>)	X		X					X		X		X						
SoilGard (<i>Gliocladium virens</i> str. GL-21)					X	X	X											
Taegro Biofungicide (<i>Bacillus subtilis</i>)					X				X									
Taegro ECO (<i>Bacillus subtilis</i> var. <i>amyloliquefaciens</i> Strain FZB24)					X	X	X		X		X				X			
Zonix (<i>Rhamnolipid</i> Biosurfactant)						X	X				X							
COPPER PRODUCTS*																		
Badge X2 (<i>copper oxychloride, copper hydroxide</i>)	X	X	X					X		X		X						
Basic Copper 53 (<i>copper sulfate</i>)	X	X	X					X		X		X						
Champ WG (<i>copper hydroxide</i>)	X	X	X					X		X		X						
CS 2005 (<i>copper sulfate pentahydrate</i>)	X	X	X					X		X		X						
Cueva Fungicide Concentrate (<i>copper octanoate</i>)	X	X	X					X				X	X				X	
Nordox 75 WG (<i>cuprous oxide</i>)	X	X	X					X		X		X						
NuCop 50DF (<i>cuprous hydroxide</i>)		X						X				X						
Nu-Cop 50 WP (<i>copper hydroxide</i>)		X ^b						X				X ^c						
Nu-Cop HB (<i>cupric hydroxide</i>)		X						X				X						
OILS																		
Cinnerate (<i>cinnamon oil</i>)												X						
Glacial Spray Fluid (<i>paraffinic oil</i>)																		X
GrasRoots (<i>cinnamon oil</i>)												X						
Mildew cure (<i>cottonseed, corn, and garlic oil</i>)												X						
Organic JMS Sylet Oil (<i>paraffinic oil</i>)										X		X						X
Organocide 3-in-1 (<i>sesame oil</i>)								X				X						
PureSpray Green (<i>mineral oil</i>)										X		X						X
SuffOil-X (<i>mineral oil</i>)												X						
Trilogy (neem extract)	X	X	X					X				X	X	X		X	X	
TriTek (<i>mineral oil</i>)												X						
POTASSIUM																		
Agricure (<i>potassium bicarbonate</i>)			X					X				X	X			X		
EcoMate ARMICARB 0 (<i>potassium bicarbonate</i>)	X		X					X		X		X				X		
Kaligreen (<i>potassium bicarbonate</i>)												X						
MilStop (<i>potassium bicarbonate</i>)	X		X					X				X				X		
Sil-Matrix (<i>potassium silicate</i>)												X						

Table 11.2 Pesticides Labeled for Organic Cucurbit Disease Management.

CLASS OF COMPOUND Product Name (active ingredient)	ALTERNARIA	ANGULAR LEAFSPOT	ANTHRACNOSE	BACTERIAL WILT	BELLY ROT	COTTONY LEAK	DAMPING OFF	DOWNY MILDEW	FUSARIUM	GUMMY STEM BLIGHT	PHYTOPHTHORA BLIGHT	POWDERY MILDEW	SCAB	SCLEROTINIA	SEED DECAY	SEPTORIA LEAF SPOT	ULOCLADIUM LEAF SPOT	VIRUSES
SULFUR^d																		
Acoidal												X						
Microthiol Disperss												X						
Micro Sulf												X						
Thiolux												X						
OTHER																		
DES-X (insecticidal soap)												X						
M-Pede (potassium salts of fatty acids)												X						
Nuke Em (citric acid)												X						
Surround WP (kaolin)												X						
PERpose Plus (hydrogen peroxide/dioxide)	X	X	X		X	X	X	X	X		X	X	X	X				
OxiDate 2.0 (hydrogen dioxide, peroxyacetic acid)	X	X	X		X	X	X	X	X	X	X	X				X	X	
TerraClean 5.0 (hydrogen dioxide, peroxyacetic acid)							X		X		X							

a-fixed copper fungicides include basic/tribasic copper sulfate, copper oxychloride sulfate, as well as copper hydroxide; b-cucumber only; c-squash only; d-sulfur can be phototoxic at temperatures above 90F therefore read the label carefully.

X=product may be used against pest in New York State and OMRI listed

Active ingredient meets EPA criteria for acute toxicity to bees

11.1 MANAGEMENT OF COMMON DISEASES

11.1.1 Bacterial Wilt, *Erwinia tracheiphila*.

Affected crop(s): Most common for cucumber. Some varieties of squash are very susceptible. The bacterium is spread by the striped cucumber beetle and the spotted cucumber beetle.

Key characteristics: Dull, green, wilted patches appear on damaged leaves. Petioles and leaves initially wilt and eventually, the entire plant wilts and then dies. Fruit may be small, poorly shaped, and wilted (Reference 1). See Cornell [bacterial wilt symptoms](#) (Link 34).

Management Options: See the Striped and Spotted Cucumber Beetles in Section 12.2.

11.1.2 Downy Mildew, *Pseudoperonospora cubensis*

Time for concern: Mid-July to the end of the season. Refer to the North American Plant Disease Forecast Center for [cucurbit downy mildew forecast](#) (Link 35)

Affected crop(s): All cucurbits

Key characteristics: Upper surfaces of leaves show angular, pale green areas bounded by leaf veins that give the impression of mosaic. See Cornell [fact sheet](#) (Link 37) and Ohio State [fact sheet](#) (Link 38). These areas turn into yellow, and later necrotic angular spots. Under wet and humid conditions, sporulation occurs on the lower leaf surface (Reference 1).

ORGANIC CUCUMBER & BUTTERNUT SQUASH PRODUCTION

Management Option	Recommendations for Downy Mildew
Scouting/thresholds	In general, follow the scouting guidelines used for Alternaria leaf blight. In areas of the state prone to infection, this disease has the potential for rapid spread with short incubation periods, so growers should be aware of disease occurrence within the area and the neighboring states. Refer to county agent newsletters, and monitor the Downy Mildew national forecast website (Link 35). See photos of early symptoms. Windblown sporangia from infected cucurbits in other areas are the primary inoculum source, followed by secondary spore production within the field (Link 62).
Resistant varieties	Plant resistant varieties of cucumbers whenever possible (see Section 6: Varieties). Some newly developed varieties have resistance to the pathogen strain that dominated before 2005 and also exhibit some suppression of the current strain. See North Carolina State’s Cucurbit Breeding website (Link 38a) for trial results including downy mildew ratings.
Site selection	If possible, select sites with good air movement that encourages leaf drying.
Cultural	Fresh market growers have had success controlling downy mildew by trellising cucumbers, although this is probably cost prohibitive for process cucumber growers.
Notes	Avoid overhead irrigation to prevent moist conditions that favor disease. See information on product efficacy at: Resource Guide for Organic Insect and Disease Management (Link 5). Also see the ATTRA publication Downy Mildew Control in Cucurbits at (Link 39).

At the time this guide was produced, the following materials were available in New York State for managing this pest and were allowable for organic production. Listing a pest on a pesticide label does not assure the pesticide’s effectiveness. The registration status of pesticides can and does change. Pesticides must be currently registered with the New York State Department of Environmental Conservation (DEC) to be used legally in NY. However, pesticides meeting the federal requirements for minimum-risk (25(b)) pesticides do not require registration. Current NY pesticide registrations can be checked on the Pesticide Product, Ingredient, and Manufacturer System [\(PIMS\) website](#) (Link 2). ALWAYS CHECK WITH YOUR CERTIFIER before using a new product.

Table 11.1.2 Pesticides Labeled for Management of Downy Mildew					
Class of Compounds Product Name (Active Ingredient)	Product Rate	PHI² (Days)	REI (Hours)	Efficacy	Comments
Actinovate AG (<i>Streptomyces lydicus</i> WYEC 108)	3-12 fl oz/acre	0	1 or until dry	2	Streptomyces lydicus products effective in 1/5 trials.
Agricure (potassium bicarbonate)	2-5 lb/acre	0	1	?	
Badge X2 (copper hydroxide, copper oxychloride)	0.5-2.5 lb/acre	-	48	1	Copper products rated ++ out of ++++ in Cornell Guidelines, where +/- =may be ineffective under high disease pressure; ++++ =very effective
Basic Copper 53 (basic copper sulfate)	2 lb/acre	up to day	24	1	See comment for Badge X2.
Champ WG (copper hydroxide)	1.5-2 lb/acre	-	48	1	See comment for Badge X2.
CS 2005 (copper sulfate pentahydrate)	19.2-25.6 oz/acre	0	48	1	See comment for Badge X2.
Cueva Fungicide Concentrate (copper octanoate)	0.5-2 gal/acre	up to day	4	1	See comment for Badge X2. Effective in 1/1 recent trial on cucumber.
Double Nickel 55 (<i>Bacillus amyloliquefaciens</i> str D747)	0.25-3 lb/acre	0	4	?	


ORGANIC CUCUMBER & BUTTERNUT SQUASH PRODUCTION

Table 11.1.2 Pesticides Labeled for Management of Downy Mildew

Class of Compounds Product Name (Active Ingredient)	Product Rate	PHI² (Days)	REI (Hours)	Efficacy	Comments
Double Nickel LC (<i>Bacillus amyloliquefaciens</i> str D747)	0.5-6 qt/acre	0	4	?	
Milstop (potassium bicarbonate)	2-5 lb/acre	0	1	3	Bicarbonate products effective in 0/1 trial on pumpkin.
Nordox 75 WG (cuprous oxide)	1-1.25 lb/acre	-	12	1	See comment for Badge X2.
Nu-Cop 50 WP (copper hydroxide)	1.5-3 lb/acre	1	24	?	See comment for Badge X2.
Nu-Cop 50DF (copper hydroxide)	1.5-2 lb/acre	1	48	1	See comment for Badge X2.
Nu-Cop HB (copper hydroxide)	1 lb/acre	-	48	1	See comment for Badge X2. Apply weekly when plants begin to vine.
Organocide (sesame oil)	1-2 gal/100 gal water	0	0	?	25(b) pesticide
Oxidate 2.0 (hydrogen dioxide, peroxyacetic acid)	32 fl oz - 1 gal /100 gal water	0	until dry	1	Repeat at 7 day intervals. Do not spray OxiDate 2.0 during conditions of intense heat, drought, or poor vine canopy. Oxidate effective in 1/1 recent trial on cucumber. Bee Hazard. This product is toxic to bees exposed to direct contact.
PERpose Plus (hydrogen peroxide)	1 fl.oz./ gal (initial/curative) 0.25-0.33 fl.oz./ gal (weekly/preventative)	-	until dry	3	For initial or curative use, apply higher rate for 1 to 3 consecutive days. Then follow with weekly/preventative treatment. Hydrogen peroxide products effective in 0/5 trials. For weekly or preventative treatments, apply lower rate every five to seven days. At first signs of disease, use curative rate then resume weekly preventative treatment. Hydrogen peroxide products effective in 0/5 trials.
Regalia (<i>Reynoutria sachalinensis</i>)	1-4 qt/acre	0	4	3	Regalia effective in 0/1 recent trial on cucumber.
Serenade ASO ¹ (<i>Bacillus subtilis</i> str QST 713)	2-6 qt/acre	0	4	1	Serenade effective in 1/1 trial.
Serenade MAX ¹ (<i>Bacillus subtilis</i> str QST 713)	1-3 lb/acre	0	4	1	Serenade effective in 1/1 trial.
Serifel (<i>Bacillus amyloliquefaciens</i>)	4-16 oz/acre	0	4	?	
Trilogy (neem oil)	0.5-1% in 25-100 gals water/A	Up to day	4	1	Neem oil product effective in 0/1 trial on squash. Maximum of 2 gal/acre/application. Bee Hazard. This product is toxic to bees exposed to direct contact.

PHI = pre-harvest interval, REI = re-entry interval. - = pre-harvest interval isn't specified on label.

Efficacy: 1- effective in half or more of recent university trials, 2- effective in less than half of recent university trials, 3-not effective in any known trials, ?- not reviewed or no research available. Sulfur and copper product efficacy ratings are based on trials with some but not all products. ¹ Serenade Opti and Serenade ASO (labeled for foliar and soil uses) will be the only formulations in the future. Formulations may differ in efficacy, especially older and newer ones. ² Note that when the REI is longer than the PHI, Worker Protection Standard requirements may necessitate waiting until after REI to harvest

 Active ingredient meets EPA criteria for acute toxicity to bees

11.1.3 Phytophthora Blight, *Phytophthora capsici*

Time for concern: Seedling stage through harvest.

Affected crop(s): All cucurbits

Key characteristics: All aboveground plant parts can be affected. Occurrence varies with crop type. Initial symptoms include a sudden, permanent wilt of infected plants (crown blight phase) and/or white yeast-like fungal growth on affected fruit. See Cornell [photo](#) ([page 89, Link 40](#)) and [fact sheet](#) ([Link 41](#)). Crown blight often starts with the growing tip collapsing and turning brown. Fruit rot is the most common symptom for cucumber and winter squash. Asymptomatic winter squash in an infected field should be harvested as soon as possible, then watched for several days for disease development before selling (References 1, 7, & 9).

Management Option	Recommendation for Phytophthora Blight
Scouting/thresholds	Record the occurrence and severity of this disease. This is important for future rotational strategies. Include any areas where water does not drain well when scouting (Link 62). Prevention is very important because Phytophthora blight is very difficult to suppress once it starts to develop in a field.
Resistant varieties	No resistant varieties are available.
Crop rotation	Phytophthora has a wide range of hosts. Use a three-year minimum rotation with other susceptible crops such as peppers, eggplants, tomatoes, snap and lima beans and other cucurbits; longer if possible.
Site selection	Select well-drained fields. Avoid planting next to other susceptible crops. Do not plant in low areas of a field. Grow bush types on raised, dome-shaped beds with plastic mulch. Vining cucurbits grown on raised beds may show more fruit infection due to a more favorable environment within the furrow. Subsoiling before planting and between rows before vining improves drainage.
Sanitation	Movement of the fungus in water and on soiled equipment can be an important means of spread between fields. Thoroughly clean equipment and boots after working in affected fields.
Cultural	Break up plantings with grass strips and non-susceptible crops. One study (Reference 22) indicated that calcium (soil and foliar applications) contributed significantly to reduced foliar infections, however copper applications were needed for significant reduction in fruit infections.

At the time this guide was produced, the following materials were available in New York State for managing this pest and were allowable for organic production. Listing a pest on a pesticide label does not assure the pesticide’s effectiveness. The registration status of pesticides can and does change. Pesticides must be currently registered with the New York State Department of Environmental Conservation (DEC) to be used legally in NY. However, pesticides meeting the federal requirements for minimum-risk (25(b)) pesticides do not require registration. Current NY pesticide registrations can be checked on the Pesticide Product, Ingredient, and Manufacturer System ([PIMS website](#)) ([Link 2](#)). ALWAYS CHECK WITH YOUR CERTIFIER before using a new product.

Table 11.1.3 Pesticides Labeled for Management of Phytophthora Blight					
Class of Compounds Product Name (Active Ingredient)	Product Rate	PHI ² (Days)	REI (Hours)	Efficacy	Comments
Actinovate AG (<i>Streptomyces lydicus</i> WYEC 108)	3-12 oz/acre soil drench	0	1 or until dry	3	Actinovate effective in 0/1 trial on pumpkin. Soil drench at planting, seedling, or transplanting.
Actinovate STP (<i>Streptomyces lydicus</i>)	4-32 oz/ cwt seed seed treatment	-	until dry	?	
Bio-Tam 2.0 (<i>Trichoderma</i>)	2.5-5 lb/acre	-	1	?	

ORGANIC CUCUMBER & BUTTERNUT SQUASH PRODUCTION

Table 11.1.3 Pesticides Labeled for Management of Phytophthora Blight					
Class of Compounds Product Name (Active Ingredient)	Product Rate	PHI² (Days)	REI (Hours)	Efficacy	Comments
<i>asperellum, Trichoderma gamsii)</i>					
Double Nickel 55 (<i>Bacillus amyloliquefaciens</i> str D747)	0.125-1 lb/acre soil treatment	0	4	?	
Double Nickel LC (<i>Bacillus amyloliquefaciens</i> str D747)	0.5-4.5 pts/acre soil treatment	0	4	?	
Oxidate 2.0 (hydrogen dioxide, peroxyacetic acid)	0.5-1 treated acre in-furrow treatment 1/3-1 gal/100 gal water band	0	until dry	?	Bee Hazard. This product is toxic to bees exposed to direct contact.
PERpose Plus (hydrogen peroxide)	1 fl.oz./ gal (initial/curative) 0.25-0.33 fl.oz./ gal (weekly/preventative)	-	until dry	?	For initial or curative use, apply higher rate for 1 to 3 consecutive days. Then follow with weekly/preventative treatment. For weekly or preventative treatments, apply lower rate every five to seven days. At first signs of disease, use curative rate then resume weekly preventative treatment.
Prestop (<i>Gliocladium catenulatum</i>)	1.4-3.5 oz/ 2.5 gal water soil drench	0	0	?	Treat only the growth substrate when above-ground harvestable food commodities are present.
Regalia (<i>Reynoutria sachalinensis</i>)	1-4 qt/acre	0	4	?	Use with a labeled rate of copper fungicide or another fungicide labeled for phytophthora control.
RootShield Granules (<i>Trichoderma harzianum</i>)	2.5-6 half acre in-furrow treatment	-	0	?	
RootShield PLUS+ Granules (<i>Trichoderma harzianum, Trichoderma virens</i>)	2.5-6 half acre in-furrow treatment	-	0	?	
RootShield PLUS+ WP (<i>Trichoderma harzianum, Trichoderma virens</i>)	16-32 oz/acre in-furrow treatment	0	4	?	Do not apply when above-ground harvestable food commodities are present.
RootShield WP (<i>Trichoderma harzianum</i>)	16-32 oz/acre in-furrow treatment	-	until spray dries	?	
Serenade Soil ¹ (<i>Bacillus subtilis</i> str QST 713)	2-6 qt/acre in-furrow treatment	0	4	?	
Taegro ECO (<i>Bacillus subtilis</i> var. amyloliquefaciens str. FZB2)	2.6-5.2 oz/acre	-	24	?	Drench on transplants, at planting or immediately following planting as in-furrow soil spray or with liquid fertilizer, or basal spray throughout season
TerraClean 5.0 (hydrogen dioxide, peroxyacetic acid)	128 fl.oz./100 gal water Soil treatment	up to day	0	?	Soil treatment prior to seeding or transplanting.

ORGANIC CUCUMBER & BUTTERNUT SQUASH PRODUCTION

Table 11.1.3 Pesticides Labeled for Management of Phytophthora Blight					
Class of Compounds Product Name (Active Ingredient)	Product Rate	PHI² (Days)	REI (Hours)	Efficacy	Comments
TerraClean 5.0 (hydrogen dioxide, peroxyacetic acid)	25 fl.oz./ 200 gal water soil drench	up to day	0	?	
Zonix (Rhamnolipid Biosurfactant)	0.5-0.8 fl.oz./ gal	-	4	?	Foliar spray, soil drench or seed or transplant spray.

PHI = pre-harvest interval, REI = re-entry interval. - = pre-harvest interval isn't specified on label.
 Efficacy: 1- effective in half or more of recent university trials, 2- effective in less than half of recent university trials, 3-not effective in any known trials, ?- not reviewed or no research available. ¹ Serenade Opti and Serenade ASO (labeled for foliar and soil uses) will be the only formulations in the future. Formulations may differ in efficacy, especially older and newer ones. ²Note that when the REI is longer than the PHI, Worker Protection Standard requirements may necessitate waiting until after REI to harvest

11.1.4 Powdery Mildew, *Podosphaera xanthii*

Time for concern: July, after fruit initiation until the end of the season. Dry leaf surfaces and humidities above 50% favor this disease.

Affected crop(s): All cucurbits

Key characteristics: Symptoms begin as circular, powdery white spots first on crown leaves and shaded lower leaves, especially on leaf undersurfaces. Eventually, leaves yellow, turn brown, and die. Fruits may be poorly colored and/or sunburned because of loss of foliage. See Cornell fact sheets (Links [42](#) and [42a](#)) and References 1, 4, and 10.

Management Option	Recommendation for Powdery Mildew
Scouting/thresholds	When first fruit start to enlarge, begin scouting weekly by examining both the upper and lower leaf surfaces of 5 old, crown leaves in at least 10 locations throughout the field. It is critical that treatments begin as soon as powdery mildew is found on at least 1 of the 50 leaves. See Cucurbit IPM Scouting Procedures (Link 62).
Indicator crop	A spring planting of summer squash will become infected before a main season crop and thus can be used as an indicator of when powdery mildew is present in an area and it is time to begin scouting winter squash.
Resistant varieties	Plant resistant varieties whenever possible (See Section 6: Varieties, Table 6.1 and 6.2). Cucumber varieties have a very high level of resistance
Crop rotation	The exact source of primary inoculum for powdery mildew in New York is not known. It has long been suspected that airborne conidia originating in southern states where cucurbit crops are grown earlier in the year could be the primary source.
Fungicide Use	A seven-day interval is recommended. It is important to begin early when disease is just starting. To obtain adequate control, fungicide is needed on the undersides of leaves.
Site selection, & Sanitation	Do not plant sequential plantings next to each other.

ORGANIC CUCUMBER & BUTTERNUT SQUASH PRODUCTION

At the time this guide was produced, the following materials were available in New York State for managing this pest and were allowable for organic production. Listing a pest on a pesticide label does not assure the pesticide's effectiveness. The registration status of pesticides can and does change. Pesticides must be currently registered with the New York State Department of Environmental Conservation (DEC) to be used legally in NY. However, pesticides meeting the federal requirements for minimum-risk (25(b)) pesticides do not require registration. Current NY pesticide registrations can be checked on the Pesticide Product, Ingredient, and Manufacturer System ([PIMS website](#) (Link 2)). ALWAYS CHECK WITH YOUR CERTIFIER before using a new product.

Table 11.1.4 Pesticides Labeled for Management of Powdery Mildew

Class of Compounds Product Name (Active Ingredient)	Product Rate	PHI ² (Days)	REI (Hours)	Efficacy	Comments
Acoidal (sulfur)	See label	-	24	1	Sulfur products effective in 18/26 trials. Sulfur products rated +++ of ++++ in Cornell Guidelines where +/- =may be ineffective under high disease pressure; ++++ =very effective. Rates are different depending on the crop treated.
Actinovate AG (Streptomyces Lydicus WYEC 108)	3-12 oz/acre	0	1 or until dry	2	Streptomyces lydicus effective in 1/15 cucurbit trials.
Agricure (Potassium bicarbonate)	2-5 lb/acre	0	1	?	
Badge X2 (copper hydroxide, copper oxychloride)	0.5-2.5 lb/acre	-	48	2	Copper based products effective in 2/7 trials. Rated ++ of ++++ in Cornell Guidelines where +/- =may be ineffective under high disease pressure; ++++ =very effective. Contact control only, mostly on upper leaf surface; fungus develops on both upper and lower leaf surface.
Basic Copper 53 (basic copper sulfate)	2 lb/acre	up to day	24	2	See comment for Badge X2.
Champ WG (copper hydroxide)	1.5-2 lb/acre	-	48	2	See comment for Badge X2.
Champion++ (copper hydroxide)	0.5-1.25 oz/acre	0	48	?	
Cinnerate (cinnamon oil)	13-30 fl oz/100 gal water	-	-	3	25(b) pesticide
CS 2005 (copper sulfate pentahydrate)	19.2-25.6 oz/acre	0	48	2	See comment for Badge X2.
Cueva Fungicide Concentrate (copper octanoate)	0.5-2 gal/acre	up to day	4	2	See comment for Badge X2.
Defend DF (sulfur)	See label	-	24	1	See comment for Badge X2.
DES-X (insecticidal soap)	2% solution sprayed at 75-200 gallons/acre	1/2	12	?	
Double Nickel 55 (Bacillus amyloliquefaciens strain D747)	0.25-3 lb/acre	0	4	?	
Double Nickel LC (Bacillus amyloliquefaciens strain D747)	0.5-6 qt/acre	0	4	?	
GrasRoots (cinnamon oil)	1 part GrasRoots: 9 parts water	-	-	?	25(b) pesticide.

ORGANIC CUCUMBER & BUTTERNUT SQUASH PRODUCTION

Table 11.1.4 Pesticides Labeled for Management of Powdery Mildew					
Class of Compounds Product Name (Active Ingredient)	Product Rate	PHI² (Days)	REI (Hours)	Efficacy	Comments
Kaligreen (Potassium bicarbonate)	2.5-5 lb/acre	1	4	2	Kaligreen effective in 3/7 trials.
Micro Sulf (sulfur)	See label	-	24	1	Sulfur products effective in 18/26 trials. Sulfur products rated +++ of ++++ in Cornell Guidelines where +/- =may be ineffective under high disease pressure; ++++ =very effective. Limit 2 lbs if temps exceed 95 degrees F. Do not use on sulfur-sensitive squash varieties. Rates are different depending on the crop treated.
Microthiol Disperss (sulfur)	See label	-	24	1	Sulfur products effective in 18/26 trials. Sulfur products rated +++ of ++++ in Cornell Guidelines where +/- =may be ineffective under high disease pressure; ++++ =very effective. Do not apply within 2 weeks of an oil application nor at temperatures over 90 degrees. Rates are different depending on the crop treated.
Mildew Cure (garlic oil, cottonseed oil, corn oil)	1%	-	-	1	25(b) pesticide. Mildew Cure effective in 1/1 trial on pumpkin.
Milstop (Potassium bicarbonate)	2-5 lb/acre	0	1	1	MilStop effective in 2/2 trials.
M-Pede (insecticidal soap)	1.5-2% v/v	0	12	?	
Nordox 75 WG (cuprous oxide)	1-1.25 lb/acre	-	12	2	See comment for Badge X2.
Nu-Cop 50 WP (copper hydroxide)	1.5-3 lb/acre	1	24	2	See comment for Badge X2. Winter squash only.
Nu-Cop 50DF (copper hydroxide)	1.5-2 lb/acre	1	48	2	See comment for Badge X2. Winter squash only.
Nu-Cop HB (copper hydroxide)	1 lb/acre	-	48	2	See comment for Badge X2. Winter squash only.
Nuke Em (citric acid)	1 fl oz/31 oz water to 2 fl oz/30 fl oz water	-	-	?	25(b) pesticide
Organic JMS Stylet-Oil (paraffinic oil)	3-6 qt/100 gal water	0	4	1	JMS Stylet-oil effective in 3/3 trials. Protectant. Use at least 200 psi spray pressure. See label for sulfur and other incompatibility information.
Organocide (sesame oil)	1-2 gal/100 gal water	-	-	1	25(b) pesticide. Organocide effective in 2/2 trials.
Oxidate 2.0 (hydrogen dioxide, peroxyacetic acid)	32 fl oz - 1 gal /100 gal water	0	until dry	?	Do not spray OxiDate 2.0 during conditions of intense heat, drought, or poor vine canopy. Bee Hazard. This product is toxic to bees exposed to direct contact.

ORGANIC CUCUMBER & BUTTERNUT SQUASH PRODUCTION

Table 11.1.4 Pesticides Labeled for Management of Powdery Mildew

Class of Compounds Product Name (Active Ingredient)	Product Rate	PHI ² (Days)	REI (Hours)	Efficacy	Comments
PERpose Plus (hydrogen peroxide)	1 fl.oz./ gal initial/curative 0.25-0.33 fl oz/ gal weekly/preventative	-	until dry	?	For initial or curative use, apply higher rate for 1 to 3 consecutive days. Then follow with weekly/preventative treatment. Hydrogen peroxide products effective in 0/5 trials. For weekly or preventative treatments, apply lower rate every five to seven days. At first signs of disease, use curative rate then resume weekly preventative treatment.
PureSpray Green (white mineral oil)	0.75-1.5 gal/acre	up to day	4	1	
Regalia (Reynoutria sachalinensis)	1-4 qt/acre	0	4	?	
Serenade ASO ¹ (Bacillus subtilis str QST 713)	2-6 qt/acre	0	4	?	
Serenade MAX ¹ (Bacillus subtilis str QST 713)	1-3 lb/acre	0	4	?	
Serifel (Bacillus amyloliquefaciens)	4-16 oz/acre	0	4	?	
Sil-Matrix (potassium silicate)	0.5-1 % solution	0	4	?	Apply at least 20 gallons of finished spray solution per acre.
SuffOil-X (aliphatic petroleum solvent)	1-2 gal/100 gal water	Up to day	4	1	Apply as needed.
Surround WP (kaolin clay)	12.5-25 lb/acre	up to day	4	?	
Thiolux (sulfur)	See label	-	24	1	Sulfur products effective in 18/26 trials. Sulfur products rated +++ of ++++ in Cornell Guidelines where +/- =may be ineffective under high disease pressure; ++++ =very effective. Rates are different depending on the crop treated.
Trilogy (neem oil)	0.5-1% in 25-100 gals water/A	Up to day	4	1	Maximum of 2 gal/acre/application. Trilogy effective in 4/6 trials. May reapply every 7-14 days. Bee Hazard. This product is toxic to bees exposed to direct contact.
TriTek (mineral oil)	1-2 gal/100 gal water	0	4	1	Apply as needed.

PHI = pre-harvest interval, REI = re-entry interval. - = pre-harvest interval isn't specified on label.

Efficacy: 1- effective in half or more of recent university trials, 2- effective in less than half of recent university trials, 3-not effective in any known trials, ?- not reviewed or no research available. Sulfur and copper product efficacy ratings are based on trials with some but not all products. ¹Serenade Opti and Serenade ASO (labeled for foliar and soil uses) will be the only formulations in the future. Formulations may differ in efficacy, especially older and newer ones. ²Note that when the REI is longer than the PHI, Worker Protection Standard requirements may necessitate waiting until after REI to harvest

 Active ingredient meets EPA criteria for acute toxicity to bees

11.1.5 Storage and Fruit Rots

Time for concern: Initial infection occurs in the field, with further development and spread in storage

Affected crop(s): Winter squash

ORGANIC CUCUMBER & BUTTERNUT SQUASH PRODUCTION

Key characteristics: This section is meant to highlight the exceptionally long list of bacterial and fungal pathogens that cause fruit loss in the field, at roadside stands, or much later while in storage, primarily due to fruit rots. The list includes [Bacterial diseases](#) - angular and bacterial leaf spot and [Fungal diseases](#) - Anthracnose, black rot (also called gummy stem blight), Fusarium crown and fruit rot, Fusarium fruit rot, Phytophthora blight, Pythium cottony leak, Rhizoctonia belly rot of cucumber, scab, Septoria leaf and fruit spot, white mold, and possibly ground stain of butternut squash. Individual disease sections should be referred to for specific control recommendations, which will include comments on crop rotation, site selection, as well as others. See Cornell [fruit rot photos](#) (Link 43).

Management Option	Recommendations for Storage and Fruit Rots
Resistant varieties	No resistant varieties are available.
Harvest	Handle fruits carefully to minimize wounding. Harvest before frost. Discard any suspect fruit as spread of inoculum from diseased to healthy fruit can occur while in storage.
Sanitation	Wooden storage boxes should be disinfected to remove pathogens and contaminating organisms that may cause decay. Storage boxes should be treated in the summer months prior to fall harvest. Whether or not the storage boxes are treated with a disinfectant, air-drying the boxes outside the storage facility during the warm, summer months will promote desiccation and death of organisms on the boxes.
Harvest Conditions	See Section 9: Harvesting, for more information about proper post-harvest handling of winter squash.
Scouting/thresholds, Crop rotation, Site selection, Seed selection/treatment	These are not currently viable management options.

11.2 Management of Nematodes

Primarily Northern root-knot (*Meloidogyne hapla*) and root-lesion (*Pratylenchus spp.*)

Time for concern: Before planting. Long-term planning is required for sustainable management.

Affected crop(s): All cucurbits

Key characteristics: In the field, plants severely infected with either nematode generally lack vigor, are stunted and can be chlorotic. Belowground, galls develop on the roots of plants infected by root-knot nematode that disrupt the uptake of nutrients and water by the roots, while the root-lesion nematode does not cause any specific symptoms on the roots.

Management Option	Recommendations for Nematodes
Scouting/thresholds	Use a soil bioassay with lettuce and/or soybean to assess soil root-knot and root-lesion nematode infestation levels, respectively. Or, submit the soil sample(s) for nematode analysis at a public or private nematology lab (Link 44). See Section 4: Field Selection for more information as well as the following Cornell publications for instructions: Soil Sampling for Plant Parasitic Nematodes (Link 45). Visual Assessment of Root-Knot Nematode Soil Infestation Levels Using a Lettuce Bioassay (Link 46). A Soil Bioassay for the Visual Assessment of Soil Infestations of Lesion Nematode (Link 47).
Resistant varieties	No resistant varieties are available.
Crop rotation	Root-knot nematode has a wide host range but grain crops including corn, wheat, barley and oat are non-hosts and therefore effective at reducing the nematode population. If both root-lesion and root-knot nematodes are present in the same field then rotation with a grain crop may increase the root-lesion nematode population to a damaging level for the next crop. In addition to grain crops, root-lesion nematode has over 400 hosts including many vegetables that are planted in rotation with

ORGANIC CUCUMBER & BUTTERNUT SQUASH PRODUCTION

Management Option	Recommendations for Nematodes
	cucurbits thus making it difficult to manage root-lesion nematode strictly using a crop rotation. Depending on the size of the infested site, marigold varieties such as ‘Polynema’ and ‘Nemagone’ are very effective at reducing nematode populations, where marigold can be established successfully.
Site selection	Assay soil for nematode infestation, if needed.
Biofumigant cover crops	Grain cover crops such as winter rye and oat are poor or non-hosts for the root-knot nematode, thus they are effective at reducing the population. Cover crops with a biofumigant effect, used as green manure are best used for managing root-lesion nematode and will also reduce root-knot nematode populations. It is important to note that many biofumigant crops including Sudangrass, white mustard, and rapeseed are hosts to root-lesion nematode and will increase the population until they are incorporated into the soil as a green manure at which point their decomposition products are toxic to nematodes. Research has suggested that Sudangrass hybrid ‘Trudan 8’ can be used effectively as a biofumigant to reduce root-lesion nematode populations. Cover crops such as forage pearl millet ‘CFPM 101’ and ‘Tifgrain 102’, rapeseed ‘Dwarf Essex’, and ryegrass ‘Pennant’ are poor hosts, and thus will limit the build-up or reduce root-lesion nematode populations when used as a “standard” cover crop.
Sanitation	Avoid moving soil from infested fields to uninfested fields via equipment and vehicles, etc. Also limit/avoid surface run-off from infested fields.
Weed Control	Many common weeds including lambsquarters, redroot pigweed, common purslane, common ragweed, common dandelion and wild mustard are hosts to root-lesion nematode; therefore effective weed management is also important.


At the time this guide was produced, the following materials were available in New York State for managing this pest and were allowable for organic production. Listing a pest on a pesticide label does not assure the pesticide’s effectiveness. The registration status of pesticides can and does change. Pesticides must be currently registered with the New York State Department of Environmental Conservation (DEC) to be used legally in NY. However, pesticides meeting the federal requirements for minimum-risk (25(b)) pesticides do not require registration. Current NY pesticide registrations can be checked on the Pesticide Product, Ingredient, and Manufacturer System [\(PIMS\) website](#) (Link 2). ALWAYS CHECK WITH YOUR CERTIFIER before using a new product.

Table 11.2.1 Pesticides for Management of Nematodes

Class of Compounds Product Name (Active Ingredient)	Product Rate	PHI ² (Days)	REI (Hours)	Efficacy	Comments
AzaGuard (azadirachtin)	15 oz/acre soil treatment	0	4	?	Apply in sufficient amount of water to penetrate in the soil to a depth of 12 inches. Repeat applications every 3 or 4 weeks or as needed.
DiTera DF (<i>Myrothecium verrucaria</i>)	13-100 lb/acre soil treatment	-	4	?	
MeloCon (<i>Paecilomyces lilacinus</i> str. 251)	2-4 lb/acre soil treatment	-	4	?	
Molt-X (azadirachtin)	15 oz/acre soil treatment	0	4	?	See comment for AzaGuard.

PHI = pre-harvest interval, REI = re-entry interval. - = pre-harvest interval isn’t specified on label.

Efficacy: 1- effective in half or more of recent university trials, 2- effective in less than half of recent university trials, 3-not effective in any known trials, ?- not reviewed or no research available. ²Note that when the REI is longer than the PHI, Worker Protection Standard requirements may necessitate waiting until after REI to harvest

 Active ingredient meets EPA criteria for acute toxicity to bees

11.3 MANAGEMENT OF DISEASES THAT OCCUR LESS FREQUENTLY

Specific control strategies for the less commonly occurring diseases are listed in Table 11.3. General control practices for these diseases include plowing under crop debris as soon after harvest as possible to eliminate spores that may infect other plantings

ORGANIC CUCUMBER & BUTTERNUT SQUASH PRODUCTION

and to give the plant material a chance to break down to reduce the amount of inoculum remaining in the soil. For foliar diseases choose sites with good air circulation to minimize leaf wetness periods. For fruit diseases, choose well-drained fields and avoid excessive overhead irrigation.

Table 11.3 Management Strategies for Less Commonly Occurring Cucurbit Diseases.

Disease	Are Resistant Varieties Available?	Rotation out of Cucurbits	Is Disease Seed-borne?	Site Selection
Alternaria leaf blight	No	2 yr	Yes	Choose sites that favor fast leaf drying. Schedule overhead irrigation so it doesn't extend overnight leaf wetness. Avoid planting next to other cucurbits.
Angular and bacterial leaf spot	C	2 yr	Yes	Avoid planting next to other cucurbits
Anthracnose	C	2 yr	Yes	Not a viable management option
Belly rot	No	NE	-	Avoid soils that don't drain well
Choanephora blossom blight and fruit rot	No	2 yr	No	Allow for good air drainage; avoid dense plantings
Cottony leak <i>Pythium</i> spp	No	NE	No	Choose well-drained sites, avoid excessive overhead irrigation
Damping off and root rot <i>Pythium</i> spp	No	NE	No	Choose well-drained site.
Fusarium wilt, Fusarium crown rot, Verticillium wilt	No	5 yr ^a	Yes	Not a viable management option
Gummy stem blight and black rot	No	2 yr	Yes	Not a viable management option
Plectosporium blight	No	2 yr	No	Avoid soils that don't drain well. Not a threat for cucumber or butternut squash.
Scab	C	2 yr	Yes	Select sites that have well-drained soils and are conducive to good air movement. Avoid planting next to other cucurbits
Sclerotinia white mold	No	4 yr ^a	No	Avoid fields with a history of white mold. Avoid dense plantings that hold humidity. Sclerotinia has a wide host range.
Seed-borne diseases and seed decay	No	NE	Yes	Do not plant into cool, wet soils. Select areas that are well-drained.
Septoria leaf spot	No	2 yr	No	Only affects winter squash
Ulocladium leaf spot	C	2 yr	No	Only affects cucumbers
Viruses (PRSV, WMV, CMV, ZYMV)	C	NE	No	Plant late-season fields as far away from existing cucurbits as possible. A weed-free zone around the field may reduce the incidence of CMV and WMV. Reflective mulches or floating row covers may help repel or exclude aphids

C=Cucumber, NE=Not Effective, ^a Because of the wide host range, rotate away from cucurbits and other susceptible crops. PRSV=Papaya Ringspot Virus, CMV=Cucumber Mosaic Virus, WMV=Watermelon Mosaic Virus, ZYMV=Zucchini Yellow Mosaic Virus.

11.3.1 Alternaria Leaf Blight, *Alternaria cucumerina*

Time for concern: When the canopy closes

Affected crop(s): All cucurbits

Key characteristics: Symptoms first appear on the upper surface of crown leaves as small, circular spots ¼ inch in diameter and later enlarge to show a target-like pattern of rings (See References 1 and 2). See University of Illinois [photos](#) (Link 48).

ORGANIC CUCUMBER & BUTTERNUT SQUASH PRODUCTION

Management Option	Recommendations for Alternaria Leaf Blight
Scouting/thresholds	<p>Scouting: As the plants begin to run (vine types) or flower (bush types), choose five representative sites. At each site, inspect two older leaves on each of five plants, for a total of 50 leaves inspected per field. Record the number of infected plants. After the row closes (vine types) or fruit that have set begin to enlarge (bush types), substitute five plant areas. Examine ten leaves and five fruit per area. Calculate and record the percent of plants infected.</p> <p>Threshold: symptoms found on one leaf per 50 leaves sampled. When the disease threshold is met, spray on a seven to ten day schedule. Use a higher rate or shorter interval under severe disease pressure. See Cucurbit IPM Scouting Procedures (Link 62).</p>

At the time this guide was produced, the following materials were available in New York State for managing this pest and were allowable for organic production. Listing a pest on a pesticide label does not assure the pesticide’s effectiveness. The registration status of pesticides can and does change. Pesticides must be currently registered with the New York State Department of Environmental Conservation (DEC) to be used legally in NY. However, pesticides meeting the federal requirements for minimum-risk (25(b)) pesticides do not require registration. Current NY pesticide registrations can be checked on the Pesticide Product, Ingredient, and Manufacturer System [\(PIMS\) website](#) (Link 2). ALWAYS CHECK WITH YOUR CERTIFIER before using a new product.

Table 11.3.1 Pesticides for Management of Alternaria Leaf Blight					
Class of Compounds Product Name (Active Ingredient)	Product Rate	PHI ² (Days)	REI (Hours)	Efficacy	Comments
Actinovate AG (Streptomyces Lydicus WYEC 108)	3-12 oz/acre	0	1 or until dry	?	
Badge X2 (copper hydroxide, copper oxychloride)	0.5-2.5 lb/acre	-	48	1	Rated + of ++++ in Cornell Guidelines where +/- =may be ineffective under high disease pressure; ++++ =very effective.
Basic Copper 53 (basic copper sulfate)	2 lb/acre	up to day	24	1	See comment for Badge X2.
Champ WG (copper hydroxide)	1.5-2 lb/acre	-	48	1	See comment for Badge X2.
Champion++ (copper hydroxide)	0.5-1.25 oz/acre	0	48	?	See comment for Badge X2.
CS 2005 (copper sulfate pentahydrate)	19.2-25.6 oz/acre	0	48	1	See comment for Badge X2.
Cueva Fungicide Concentrate (copper octanoate)	0.5-2 gal/acre	up to day	4	1	See comment for Badge X2.
Milstop (Potassium bicarbonate)	2-5 lb/acre	0	1	?	
Nordox 75 WG (cuprous oxide)	1-1.25 lb/acre	-	12	1	See comment for Badge X2. Repeat on 7-10 day intervals.
Oxidate 2.0 (hydrogen dioxide, peroxyacetic acid)	32 fl oz - 1 gal /100 gal water	0	until dry	?	Do not spray OxiDate 2.0 during conditions of intense heat, drought, or poor vine canopy. Bee Hazard. This product is toxic to bees exposed to direct contact.
PERpose Plus (hydrogen peroxide)	1 fl.oz./ gal (initial/curative) 0.25-0.33 fl.oz./ gal (weekly/preventative)	-	until dry	?	For initial or curative use, apply higher rate for 1 to 3 consecutive days. Then follow with weekly/preventative treatment. For weekly or preventative treatments, apply lower rate every five to seven days. At first signs of disease, use curative rate then resume weekly preventative treatment.

ORGANIC CUCUMBER & BUTTERNUT SQUASH PRODUCTION


Table 11.3.1 Pesticides for Management of Alternaria Leaf Blight

Class of Compounds Product Name (Active Ingredient)	Product Rate	PHI ² (Days)	REI (Hours)	Efficacy	Comments
Prestop (Gliocladium catenulatum)	1.4-3.5 oz/ 2.5 gal water soil drench	0	0	?	Treat only the growth substrate when above-ground harvestable food commodities are present.
Regalia (Reynoutria sachalinensis)	1-4 qt/acre	0	4	?	
Serifel (Bacillus amyloliquefaciens)	4-16 oz/acre	0	4	?	
Trilogy (neem oil)	0.5-1% in 25-100 gals water/A	Up to day	4	?	Maximum of 2 gal/acre/application. May reapply every 7-14 days. Bee Hazard. This product is toxic to bees exposed to direct contact.

PHI = pre-harvest interval, REI = re-entry interval. - = pre-harvest interval isn't specified on label.

Efficacy: 1- effective in half or more of recent university trials, 2- effective in less than half of recent university trials, 3-not effective in any known trials, ?- not reviewed or no research available.

Rated + of ++++ in [Cornell Guidelines](#) where +/- =may be ineffective under high disease pressure; ++++ =very effective. Sulfur and copper product efficacy ratings are based on trials with some but not all products. ²Note that when the REI is longer than the PHI, Worker Protection Standard requirements may necessitate waiting until after REI to harvest

 Active ingredient meets EPA criteria for acute toxicity to bees

11.3.2 Angular Leaf Spot, *Pseudomonas syringae* pv. *lachrymans*, and Bacterial Leaf Spot, *Xanthomonas campestris* pv. *cucurbitae*

Time for concern: Early to mid-season as immature fruit appear and develop

Affected crop(s): All cucurbits

Key characteristics: Angular leaf spot- brown, water-soaked spots are 1/25 to 3/25 inch in length and angular in shape. See University of Minnesota [fact sheet](#) (Link 49) Cornell [photos](#) (Link 50, page 88).


Bacterial leaf spot - spots are similar in color and size to angular leaf spot, but circular. Under moist conditions, small droplets of ooze come from the water-soaked areas and dry as white residue. The fruit may have sunken craters with white crust (References 1 and 2). See Cornell [photos](#) (Link 50a)

Management Option	Recommendations for Angular Leaf Spot
Scouting/thresholds	Scouting: Use the following scouting method for angular leaf spot, anthracnose, scab, Septoria, and Ulocladium. As the plants begin to run (vine types), choose five representative sites. At each site, inspect two older leaves on each of five plants, for a total of 50 leaves inspected per field. Record the number of infected plants. After the row closes (vine types) or fruit that have set begin to enlarge (bush types), substitute five plant areas. Examine ten leaves and five fruit per area. Calculate and record the percent of plants infected. Threshold: symptoms found on one leaf per 50 leaves sampled. See Cucurbit IPM Scouting Procedures (Link 62).
Resistant Varieties	Plant resistant varieties (Section 6: Varieties).
Crop Rotation	Rotate away from cucurbits for 2 to 4 years.

ORGANIC CUCUMBER & BUTTERNUT SQUASH PRODUCTION


At the time this guide was produced, the following materials were available in New York State for managing this pest and were allowable for organic production. Listing a pest on a pesticide label does not assure the pesticide's effectiveness. The registration status of pesticides can and does change. Pesticides must be currently registered with the New York State Department of Environmental Conservation (DEC) to be used legally in NY. However, pesticides meeting the federal requirements for minimum-risk (25(b)) pesticides do not require registration. Current NY pesticide registrations can be checked on the Pesticide Product, Ingredient, and Manufacturer System [\(PIMS\) website](#) (Link 2). ALWAYS CHECK WITH YOUR CERTIFIER before using a new product.

Table 11.3.2 Pesticides for Management of Angular Leaf Spot

Class of Compounds Product Name (Active Ingredient)	Product Rate	PHI ² (Days)	REI (Hours)	Efficacy	Comments
Badge X2 (copper hydroxide, copper oxychloride)	0.5-2.5 lb/acre	-	48	1	Rated + of ++++ in Cornell Guidelines where +/- =may be ineffective under high disease pressure; ++++ =very effective.
Basic Copper 53 (basic copper sulfate)	2 lb/acre	up to day	24	1	See comment for Badge X2.
Champ WG (copper hydroxide)	1.5-2 lb/acre	-	48	1	See comment for Badge X2.
Champion++ (copper hydroxide)	0.5-1.25 oz/acre	0	48	?	See comment for Badge X2.
CS 2005 (copper sulfate pentahydrate)	19.2-25.6 oz/acre	0	48	1	See comment for Badge X2.
Cueva Fungicide Concentrate (copper octanoate)	0.5-2 gal/acre	up to day	4	1	See comment for Badge X2.
Nordox 75 WG (cuprous oxide)	1-1.25 lb/acre	-	12	1	See comment for Badge X2.
Nu-Cop 50 WP (copper hydroxide)	1.5-2 lb/acre Cucumber only	1	24	1	See comment for Badge X2. Cucumber only.
Nu-Cop 50DF (copper hydroxide)	1.5-2 lb/acre	1	48	1	See comment for Badge X2. Cucumber only.
Nu-Cop HB (copper hydroxide)	0.75-1 lb/acre	-	48	1	See comment for Badge X2. Cucumber only.
Oxidate 2.0 (hydrogen dioxide, peroxyacetic acid)	32 fl oz - 1 gal /100 gal water	0	until dry	?	Bee Hazard. This product is toxic to bees exposed to direct contact.
PERpose Plus (hydrogen peroxide)	1 fl.oz./ gal initial/curative 0.25-0.33 fl.oz./ gal weekly/preventative	-	until dry	?	For initial or curative use, apply higher rate for 1 to 3 consecutive days. Then follow with weekly/preventative treatment. For weekly or preventative treatments, apply lower rate every five to seven days. At first signs of disease, use curative rate then resume weekly preventative treatment.
Trilogy ( neem oil)	0.5-1% in 25-100 gals water/A	Up to day	4	?	Maximum of 2 gal/acre/application. May reapply every 7-14 days. Bee Hazard. This product is toxic to bees exposed to direct contact.

PHI = pre-harvest interval, REI = re-entry interval. - = pre-harvest interval isn't specified on label.

Efficacy: 1- effective in half or more of recent university trials, 2- effective in less than half of recent university trials, 3-not effective in any known trials, ?- not reviewed or no research available. Sulfur and copper product efficacy ratings are based on trials with some but not all products. ²Note that when the REI is longer than the PHI, Worker Protection Standard requirements may necessitate waiting until after REI to harvest

 Active ingredient meets EPA criteria for acute toxicity to bees

11.3.3 Anthracnose, *Colletotrichum orbiculare*

Time for concern: During warm, moist seasons and also a post harvest problem for winter squash

Affected crop(s): All cucurbits

Key characteristics: Leaf lesions begin as water-soaked spots that become yellow and circular. The fruit develops circular, black, sunken cankers. When moisture is present, the black center of the lesion is covered with salmon-colored spores (see References 1, 4, 5, and 6). See Cornell [fact sheet](#) (Link 51)

Scouting/thresholds: Use the following scouting method for angular leaf spot, anthracnose, scab, septoria, and ulocladium. As the plants begin to run, choose five representative sites. At each site, inspect two older leaves on each of five plants, for a total of 50 leaves inspected per field. Record the number of infected plants. After the row closes, substitute five plant areas. Examine ten leaves and five fruit per area. Calculate and record the percent of plants infected. **Threshold:** symptoms found on one leaf per 50 leaves sampled. See [Cucurbit IPM Scouting Procedures](#) (Link 62).

At the time this guide was produced, the following materials were available in New York State for managing this pest and were allowable for organic production. Listing a pest on a pesticide label does not assure the pesticide's effectiveness. The registration status of pesticides can and does change. Pesticides must be currently registered with the New York State Department of Environmental Conservation (DEC) to be used legally in NY. However, pesticides meeting the federal requirements for minimum-risk (25(b)) pesticides do not require registration. Current NY pesticide registrations can be checked on the Pesticide Product, Ingredient, and Manufacturer System [\(PIMS\) website](#) (Link 2). ALWAYS CHECK WITH YOUR CERTIFIER before using a new product.

Table 11.3.3 Pesticides for Management of Anthracnose					
Class of Compounds Product Name (Active Ingredient)	Product Rate	PHI ² (Days)	REI (Hours)	Efficacy	Comments
Actinovate AG (<i>Streptomyces lydicus</i> WYEC 108)	3-12 oz/acre	0	1 or until dry	?	
Agricure (potassium bicarbonate)	2-5 lb/acre	0	1	?	
Badge X2 (copper hydroxide, copper oxychloride)	0.5-2.5 lb/acre	-	48	1	Rated + of ++++ in Cornell Guidelines where +/- =may be ineffective under high disease pressure; ++++ =very effective.
Basic Copper 53 (basic copper sulfate)	2 lb/acre	up to day	24	1	See comment for Badge X2.
Champ WG (copper hydroxide)	1.5-2 lb/acre	-	48	1	See comment for Badge X2.
Champion++ (copper hydroxide)	0.5-1.25 oz/acre	0	48	?	
CS 2005 (copper sulfate pentahydrate)	19.2-25.6 oz/acre	0	48	1	See comment for Badge X2.
Cueva Fungicide Concentrate (copper octanoate)	0.5-2 gal/acre	up to day	4	1	See comment for Badge X2.
Milstop (Potassium bicarbonate)	2-5 lb/acre	0	1	?	
Nordox 75 WG (cuprous oxide)	1-1.25 lb/acre	-	12	1	See comment for Badge X2.
Oxidate 2.0 (hydrogen dioxide, peroxyacetic acid)	32 fl oz - 1 gal /100 gal water	0	until dry	?	Bee Hazard. This product is toxic to bees exposed to direct contact.
PERpose Plus (hydrogen peroxide)	1 fl.oz./ gal (initial/curative) 0.25-0.33	-	until dry	?	For initial or curative use, apply higher rate for 1 to 3 consecutive days. Then follow with weekly/preventative treatment. For weekly or preventative treatments, apply

ORGANIC CUCUMBER & BUTTERNUT SQUASH PRODUCTION

Table 11.3.3 Pesticides for Management of Anthracnose

Class of Compounds Product Name (Active Ingredient)	Product Rate	PHI ² (Days)	REI (Hours)	Efficacy	Comments
	fl.oz./ gal (weekly/preventative)				lower rate every five to seven days. At first signs of disease, use curative rate then resume weekly preventative treatment.
Regalia (Reynoutria sachalinensis)	1-4 qt/acre	0	4	?	Repeat on 7-10 day intervals.
Serifel (Bacillus amyloliquifaciens)	4-16 oz/acre	0	4	?	
Trilogy (neem oil)	0.5-1% in 25-100 gals water/A	Up to day	4	?	Maximum of 2 gal/acre/application. Bee Hazard. This product is toxic to bees exposed to direct contact.

PHI = pre-harvest interval, REI = re-entry interval. - = pre-harvest interval isn't specified on label.

Efficacy: 1- effective in half or more of recent university trials, 2- effective in less than half of recent university trials, 3-not effective in any known trials, ?- not reviewed or no research available. Sulfur and copper product efficacy ratings are based on trials with some but not all products. ²Note that when the REI is longer than the PHI, Worker Protection Standard requirements may necessitate waiting until after REI to harvest

☞ Active ingredient meets EPA criteria for acute toxicity to bees

11.3.4 Belly Rot, *Rhizoctonia solani*

Time for concern: Fruit set through harvest

Affected crop(s): Cucumber

Key characteristics: Water-soaked, tan to brown lesions on undersides and blossom ends of cucumber fruits. Lesions become sunken, irregular, and dry as they enlarge. Belly Rot is a possible cause of ground stain in winter squash. See North Carolina State University [photos](#) (Link 52).

Scouting/thresholds: The most critical time to scout is when immature fruit are in contact with the soil. No thresholds have been established.

At the time this guide was produced, the following materials were available in New York State for managing this pest and were allowable for organic production. Listing a pest on a pesticide label does not assure the pesticide's effectiveness. The registration status of pesticides can and does change. Pesticides must be currently registered with the New York State Department of Environmental Conservation (DEC) to be used legally in NY. However, pesticides meeting the federal requirements for minimum-risk (25(b)) pesticides do not require registration. Current NY pesticide registrations can be checked on the Pesticide Product, Ingredient, and Manufacturer System [\(PIMS\) website](#) (Link 2). ALWAYS CHECK WITH YOUR CERTIFIER before using a new product.

Table 11.3.4 Pesticides for Management of Belly Rot

Class of Compounds Product Name (Active Ingredient)	Product Rate	PHI ² (Days)	REI (Hours)	Efficacy	Comments
Actinovate AG (<i>Streptomyces lydicus</i> WYEC 108)	3-12 oz/acre	0	1 or until dry	?	Foliar spray or soil drench.
Actinovate AG (<i>Streptomyces lydicus</i> WYEC 108)	1-12 oz/acre Soil treatment	0	1 or until dry	?	Soil treatment at planting, seeding, or transplanting.
BIO-TAM (<i>Trichoderma asperellum</i> , <i>Trichoderma gamsii</i>)	1.5-3 1000 ft row in-furrow treatment 2.5-3 lb/acre band 2.5-5 lb/acre broadcast	-	1	?	
Bio-Tam 2.0 (<i>Trichoderma asperellum</i> , <i>Trichoderma gamsii</i>)	2.5-5 lb/acre	-	1	?	
Oxidate 2.0 (hydrogen	1/2 - 1 gal in 50-200 gal	0	until	?	Bee Hazard. This product is toxic to bees

ORGANIC CUCUMBER & BUTTERNUT SQUASH PRODUCTION

Table 11.3.4 Pesticides for Management of Belly Rot

Class of Compounds Product Name (Active Ingredient)	Product Rate	PHI ² (Days)	REI (Hours)	Efficacy	Comments
dioxide, peroxyacetic acid)	water in-furrow treatment 1/3-1 gal/100 gal water band		dry		exposed to direct contact.
PERpose Plus (hydrogen peroxide)	1 fl.oz./ gal (initial/curative) soil drench	-	until dry	?	For initial or curative use, apply higher rate for 1 to 3 consecutive days.
Prestop (<i>Gliocladium catenulatum</i>)	1.4-3.5 oz/ 2.5 gal water soil drench	0	0	?	Treat only the growth substrate when above-ground harvestable food commodities are present.
Regalia (<i>Reynoutria sachalinensis</i>)	1-3 qt/100 gal water soil drench	0	4	?	
RootShield Granules (<i>Trichoderma harzianum</i>)	2.5-6 half acre in-furrow treatment	-	0	?	
RootShield PLUS+ Granules (<i>Trichoderma harzianum</i> , <i>Trichoderma virens</i>)	2.5-6 half acre in-furrow treatment	-	0	?	
RootShield PLUS+ WP (<i>Trichoderma harzianum</i> , <i>Trichoderma virens</i>)	16-32 oz/acre in-furrow treatment	0	4	?	Do not apply when above-ground harvestable food commodities are present.
RootShield WP (<i>Trichoderma harzianum</i>)	16-32 oz/acre in-furrow treatment	-	Until spray dries	?	
Serenade Soil ¹ (<i>Bacillus subtilis</i> str QST 713)	2-6 qt/acre in-furrow treatment	0	4	?	
Soilgard (<i>Gliocladium virens</i>)	2-10 lb/acre in-furrow treatment	-	0	?	
Taegro (<i>Bacillus subtilis</i>)	3 tsp/gal water Seed treatment 2.6 oz/100 gal water in-furrow treatment	-	24	?	Soil drench or over furrow at time of planting.
Taegro ECO (<i>Bacillus subtilis</i> var. amyloliquefaciens str. FZB2)	2.6-5.2 oz/acre	-	24	?	Drench on transplants, at planting or immediately following planting as in-furrow soil spray or with liquid fertilizer, or basal spray throughout season

PHI = pre-harvest interval, REI = re-entry interval. - = pre-harvest interval isn't specified on label.

Efficacy: 1- effective in half or more of recent university trials, 2- effective in less than half of recent university trials, 3-not effective in any known trials, ?- not reviewed or no research available. ¹Serenade Opti and Serenade ASO (labeled for foliar and soil uses) will be the only formulations in the future. Formulations may differ in efficacy, especially older and newer ones. ²Note that when the REI is longer than the PHI, Worker Protection Standard requirements may necessitate waiting until after REI to harvest

11.3.5 Choanephora Blossom Blight and Fruit Rot

Time for concern: Rainy weather during blossom and fruit set stage

Affected crop(s): Winter squash

Key characteristics: Fungus gets established in senescent blossoms and grows into fruit, which then rot (see Reference 1).

ORGANIC CUCUMBER & BUTTERNUT SQUASH PRODUCTION

Scouting/thresholds: Record the occurrence and severity of blossom blight and fruit rot. No thresholds have been established.

11.3.6 Cottony Leak, *Pythium spp.*

Time for concern: Fruit set through harvest

Affected crop(s): Cucumber and winter squash

Key characteristics: Brown, water-soaked lesions appear on the fruit and become watery and soft. Infected areas become covered with cottony growth. See North Carolina State University [photos](#) (Link 52) and see Reference 1.

Scouting/thresholds: Primarily a problem for cucumbers, but also observed on winter squash. No thresholds have been established.

At the time this guide was produced, the following materials were available in New York State for managing this pest and were allowable for organic production. Listing a pest on a pesticide label does not assure the pesticide’s effectiveness. The registration status of pesticides can and does change. Pesticides must be currently registered with the New York State Department of Environmental Conservation (DEC) to be used legally in NY. However, pesticides meeting the federal requirements for minimum-risk (25(b)) pesticides do not require registration. Current NY pesticide registrations can be checked on the Pesticide Product, Ingredient, and Manufacturer System [\(PIMS\) website](#) (Link 2). ALWAYS CHECK WITH YOUR CERTIFIER before using a new product.

Table 11.3.6 Pesticides for Management of Cottony Leak					
Class of Compounds Product Name (Active Ingredient)	Product Rate	PHI² (Days)	REI (Hours)	Efficacy	Comments
Actinovate AG (<i>Streptomyces ydicus</i> WYEC 108)	3-12 oz/acre soil treatment	0	1 or until dry	?	Soil treatment at planting, seeding, or transplanting.
Actinovate STP (<i>Streptomyces ydicus</i>)	4-32 oz/ cwt seed seed treatment	-	until dry	?	
BIO-TAM (<i>Trichoderma asperellum</i> , <i>Trichoderma gamsii</i>)	2.5-5 lb/acre broadcast 1.5-3 fl oz/ 1000 ft row in-furrow treatment 2.5-3 lb/acre band	-	1	?	
Bio-Tam 2.0 (<i>Trichoderma asperellum</i> , <i>Trichoderma gamsii</i>)	2.5-5 lb/acre	-	1	?	
Oxidate 2.0 (hydrogen dioxide, peroxyacetic acid)	1/2 - 1 gal in 50-200 gal water in-furrow treatment 1/3-1 gal/100 gal water band	0	until dry	?	Bee Hazard. This product is toxic to bees exposed to direct contact.
PERpose Plus (hydrogen peroxide)	1 fl.oz./ gal (initial/curative) soil drench	-	until dry	?	For initial or curative use, apply higher rate for 1 to 3 consecutive days.
Prestop (<i>Gliocladium catenulatum</i>)	1.4-3.5 oz/ 2.5 gal water soil drench	0	0	?	Treat only the growth substrate when above-ground harvestable food commodities are present.
Regalia (<i>Reynoutria sachalinensis</i>)	1-3 qt/100 gal water soil drench	0	4	?	
RootShield Granules (<i>Trichoderma harzianum</i>)	2.5-6 half acre in-furrow treatment	-	0	?	

Table 11.3.6 Pesticides for Management of Cottony Leak

Class of Compounds Product Name (Active Ingredient)	Product Rate	PHI ² (Days)	REI (Hours)	Efficacy	Comments
RootShield PLUS+ Granules (<i>Trichoderma harzianum</i> , <i>Trichoderma virens</i>)	2.5-6 half acre in-furrow treatment	-	0	?	
RootShield PLUS+ WP (<i>Trichoderma harzianum</i> , <i>Trichoderma virens</i>)	16-32 oz/acre in-furrow treatment	0	4	?	Do not apply when above-ground harvestable food commodities are present.
RootShield WP (<i>Trichoderma harzianum</i>)	16-32 oz/acre in-furrow treatment	-	Until spray dries	?	
Serenade Soil ¹ (<i>Bacillus subtilis</i> str QST 713)	2-6 qt/acre in-furrow treatment	0	4	?	
Soilgard (<i>Gliocladium virens</i>)	2-10 lb/acre	-	0	?	Used as a directed spray or drench at the base of the plant after transplanting. Repeated applications can be made as needed.
Taegro ECO (<i>Bacillus subtilis</i> var. amyloliquefaciens str. FZB2)	2.6-5.2 oz/acre	-	24	?	Drench on transplants, at planting or immediately following planting as in-furrow soil spray or with liquid fertilizer, or basal spray throughout season
Zonix (Rhamnolipid Biosurfactant)	0.5-0.8 fl oz/ gal	-	4	?	Foliar spray, soil drench or seed or transplant spray.

PHI = pre-harvest interval, REI = re-entry interval. - = pre-harvest interval isn't specified on label.

Efficacy: 1- effective in half or more of recent university trials, 2- effective in less than half of recent university trials, 3-not effective in any known trials, ?- not reviewed or no research available. ¹ Serenade Opti and Serenade ASO (labeled for foliar and soil uses) will be the only formulations in the future. Formulations may differ in efficacy, especially older and newer ones. ²Note that when the REI is longer than the PHI, Worker Protection Standard requirements may necessitate waiting until after REI to harvest

11.3.7 Damping-off and Root Rot, *Pythium spp.*

Time for concern: Seeding through harvest

Affected crop(s): Cucumber and winter squash that are direct-seeded

Key characteristics: Watery rot develops in taproot and hypocotyl at or near the soil line. Seedlings eventually die. Mature plants show symptoms of root and crown rot. See Reference 1.

Scouting/thresholds: This problem occurs early in the season if the soil is excessively wet. No thresholds have been established.

At the time this guide was produced, the following materials were available in New York State for managing this pest and were allowable for organic production. Listing a pest on a pesticide label does not assure the pesticide's effectiveness. The registration status of pesticides can and does change. Pesticides must be currently registered with the New York State Department of Environmental Conservation (DEC) to be used legally in NY. However, pesticides meeting the federal requirements for minimum-risk (25(b)) pesticides do not require registration. Current NY pesticide registrations can be checked on the Pesticide Product, Ingredient, and Manufacturer System ([PIMS website](#) (Link 2)). ALWAYS CHECK WITH YOUR CERTIFIER before using a new product.

Table 11.3.7 Pesticides for Management of Damping-off and Root Rot

Class of Compounds Product Name (Active Ingredient)	Product Rate	PHI ² (Days)	REI (Hours)	Efficacy	Comments
Actinovate AG (<i>Streptomyces lydicus</i> WYEC 108)	3-12 oz/acre Soil treatment	0	1 or until dry	?	Soil treatment at planting, seeding, or transplanting.
Actinovate STP (<i>Streptomyces lydicus</i>)	4-32 oz/ cwt seed Seed treatment	-	1 or until dry	?	

ORGANIC CUCUMBER & BUTTERNUT SQUASH PRODUCTION

Table 11.3.7 Pesticides for Management of Damping-off and Root Rot					
Class of Compounds Product Name (Active Ingredient)	Product Rate	PHI² (Days)	REI (Hours)	Efficacy	Comments
BIO-TAM (<i>Trichoderma asperellum</i> , <i>Trichoderma gamsii</i>)	2.5-5 lb/acre broadcast 1.5-3 fl oz/ 1000 ft row in-furrow treatment 2.5-3 lb/acre band	-	1	?	
Bio-Tam 2.0 (<i>Trichoderma asperellum</i> , <i>Trichoderma gamsii</i>)	1.5-3 1000 row ft	-	1	?	
Double Nickel 55 (<i>Bacillus amyloliquefaciens</i> strain D747)	0.125-1 lb/acre Soil treatment	0	4	?	
Double Nickel LC (<i>Bacillus amyloliquefaciens</i> strain D747)	0.5-4.5 pts/acre Soil treatment	0	4	?	
Mycostop (<i>Streptomyces grievoviridis</i> strain K61)	.176 oz./ 250-500 sq ft Soil treatment	-	4	?	Irrigate within 6 hours after soil spray or drench with enough water to move Mycostop into the root zone.
Mycostop Mix (<i>Streptomyces grievoviridis</i> strain K61)	.0175-.07 oz./ 100 sq ft Soil treatment 0.5-1 lb treated acre in-furrow treatment	-	4	?	Do not treat cucurbit seeds with Mycostop Mix. Lightly incorporate into the top 2-3 inches of soil.
Oxidate 2.0 (hydrogen dioxide, peroxyacetic acid)	1/2 - 1 gal in 50-200 gal water in-furrow treatment 1/3-1 gal/100 gal water band	0	until dry	?	Bee Hazard. This product is toxic to bees exposed to direct contact.
PERpose Plus (hydrogen peroxide)	1 fl.oz./ gal (initial/curative) soil drench	-	until dry	3	For initial or curative use, apply higher rate for 1 to 3 consecutive days. Hydrogen peroxide products effective on cucumber plants in 0/1 trial.
Prestop (<i>Gliocladium catenulatum</i>)	1.4-3.5 oz/ 2.5 gal water soil drench	0	0	?	Treat only the growth substrate when above-ground harvestable food commodities are present.
Regalia (<i>Reynoutria sachalinensis</i>)	1-3 qt/100 gal water soil drench	0	4	?	
RootShield Granules (<i>Trichoderma harzianum</i>)	2.5-6 half acre in-furrow treatment	-	0	3	<i>Trichoderma harzianum</i> based products effective in 0/2 trials.
RootShield PLUS+ Granules (<i>Trichoderma harzianum</i> , <i>Trichoderma virens</i>)	2.5-6 half acre in-furrow treatment	-	0	3	See comment for RootShield Granules.
RootShield PLUS+ WP (<i>Trichoderma harzianum</i> , <i>Trichoderma virens</i>)	16-32 oz/acre in-furrow treatment	0	4	3	See comment for RootShield Granules..

ORGANIC CUCUMBER & BUTTERNUT SQUASH PRODUCTION

Table 11.3.7 Pesticides for Management of Damping-off and Root Rot					
Class of Compounds Product Name (Active Ingredient)	Product Rate	PHI² (Days)	REI (Hours)	Efficacy	Comments
RootShield WP (<i>Trichoderma harzianum</i>)	16-32 oz/acre in-furrow treatment	-	Until spray dries	3	See comment for RootShield Granules. In-furrow or transplant starter solution.
Serenade Soil ¹ (<i>Bacillus subtilis</i> str QST 713)	2-6 qt/acre in-furrow treatment	0	4	?	
Soilgard (<i>Gliocladium virens</i>)	2-10 lb/acre	-	0	?	Used as a directed spray or drench at the base of the plant after transplanting. Repeated applications can be made as needed.
Taegro ECO (<i>Bacillus subtilis</i> var. amyloliquefaciens str. FZB2)	2.6-5.2 oz/acre	-	24	?	Drench on transplants, at planting or immediately following planting as in-furrow soil spray or with liquid fertilizer, or basal spray throughout season
TerraClean 5.0 (hydrogen dioxide, peroxyacetic acid)	128 fl.oz./100 gal water Soil treatment	Up to day	0	?	Soil treatment prior to seeding or transplanting.
Zonix (Rhamnolipid Biosurfactant)	0.5-0.8 fl.oz./ gal foliar spray	-	4	?	Foliar spray, soil drench or seed or transplant spray.

PHI = pre-harvest interval, REI = re-entry interval. - = pre-harvest interval isn't specified on label.

Efficacy: 1- effective in half or more of recent university trials, 2- effective in less than half of recent university trials, 3-not effective in any known trials, ?- not reviewed or no research available. ²Note that when the REI is longer than the PHI, Worker Protection Standard requirements may necessitate waiting until after REI to harvest

11.3.8 Fusarium Wilt, *Fusarium oxysporum f. sp. melonis* (Races 0, 1, and 2); *Fusarium crown and foot rot, Fusarium solani f. sp. cucurbitae* (Race 1); and *Verticillium wilt, Verticillium dahliae*

Time for concern: Mid-season to harvest

Affected crop(s): Squash are particularly susceptible to Fusarium crown and foot rot. Cucumbers are less susceptible.

Key characteristics: Two races of Fusarium wilt of melon (Race 1 and 2) occur in New York. Leaves yellow and wilt. Stems may show gummy exudate and exhibit vascular discoloration. Affected plants exhibit crown necrosis and often visible fungal growth (mycelium); plants are stunted and eventually wilt. Verticillium wilt has been implicated with wilt of cucumber (see References 1 and 6). See Cornell [fact sheet](#). (Link 53).

Scouting/Thresholds: Record the occurrence and severity of these diseases. No thresholds have been established. (see References 3 and 6).

Notes: Liming soil to a pH of 6.5-7.0 can reduce wilt.

At the time this guide was produced, the following materials were available in New York State for managing this pest and were allowable for organic production. Listing a pest on a pesticide label does not assure the pesticide's effectiveness. The registration status of pesticides can and does change. Pesticides must be currently registered with the New York State Department of Environmental Conservation (DEC) to be used legally in NY. However, pesticides meeting the federal requirements for minimum-risk (25(b)) pesticides do not require registration. Current NY pesticide registrations can be checked on the Pesticide Product, Ingredient, and Manufacturer System [\(PIMS\) website](#) (Link 2). ALWAYS CHECK WITH YOUR CERTIFIER before using a new product.

TABLE 11.3.8 Pesticides Labeled for Management of Fusarium Wilt					
Class of Compounds Product Name (Active Ingredient)	Product Rate	PHI (Days)	REI (Hours)	Efficacy	Comments
MycoStop (<i>Streptomyces grievoviridis</i> str K61)	.176 oz/ 250-500 sq ft Soil treatment	-	4	?	Irrigate within 6 hours after soil spray or drench with enough water to move Mycostop into the root zone.
MycoStop Mix (<i>Streptomyces</i>)	0.5-1 lb./	-	4	?	Irrigate within 6 hours after soil spray or drench with enough water to move Mycostop into the

ORGANIC CUCUMBER & BUTTERNUT SQUASH PRODUCTION

TABLE 11.3.8 Pesticides Labeled for Management of Fusarium Wilt

Class of Compounds Product Name (Active Ingredient)	Product Rate	PHI (Days)	REI (Hours)	Efficacy	Comments
<i>grieviridis</i> str K61)	treated acre				root zone. Lightly incorporate into the top 2-3 inches of soil. Use at planting. Band, in-furrow or side dress.
Mycostop Mix (<i>Streptomyces grieviridis</i> str K61)	7.6-30 oz/acre Soil treatment	-	4	?	Do not treat cucurbit seeds with Mycostop Mix.
Prestop (<i>Gliocladium catenulatum</i>)	1.4-3.5 oz/ 2.5 gal water soil drench	0	0	?	Treat only the growth substrate when above-ground harvestable food commodities are present.

PHI = pre-harvest interval, REI = re-entry interval. - = pre-harvest interval isn't specified on label.
 Efficacy: 1- effective in half or more of recent university trials, 2- effective in less than half of recent university trials, 3-not effective in any known trials, ?- not reviewed or no research available.

11.3.9 Gummy Stem Blight (foliar phase) and **Black Rot** (fruit rot phase); *Didymella bryoniae* (sexual stage) and *Phoma cucurbitacearum* (asexual stage)

Time for concern: Mid-July through harvest and storage

Affected crop(s): All cucurbits

Key characteristics: On foliage, symptoms vary from water-soaked areas often first near the margin or as individual, circular tan to dark brown spots. On stems, brown cankers develop, and reddish to black exudate may appear. Often, black pepper-sized specks appear in the spots and cankers, which are the small, fruiting bodies of the fungus. Foliar symptoms are less common on winter squash (see References 1, 7, and 8). See Cornell [fact sheet](#) (Link 54).

Management Option	Recommendations for Gummy Stem Blight and Black Rot
Scouting /Thresholds	None established
Crop Rotation	Rotate to a non-cucurbit crop for 2 years
Sanitation	As soon as a cucurbit crop is harvested, the decaying crop debris should be plowed under to destroy infected debris and reduce inoculum.
Harvest	Avoid injuring fruit when harvesting, as these wounds allow the pathogen to enter and the fruit could rot in storage. Cutting stems short can help reduce injury.
Notes	Do not use seed from infected fruit Moisture is necessary for the pathogen to infect. Optimal conditions for the pathogen are: relative humidity of 85% or higher, and 1-10 hours of free moisture on the leaves (due to rainfall, dew, or irrigation). Thus, it is important to minimize free moisture on the leaf surfaces by using drip rather than overhead irrigation.

At the time this guide was produced, the following materials were available in New York State for managing this pest and were allowable for organic production. Listing a pest on a pesticide label does not assure the pesticide's effectiveness. The registration status of pesticides can and does change. Pesticides must be currently registered with the New York State Department of Environmental Conservation (DEC) to be used legally in NY. However, pesticides meeting the federal requirements for minimum-risk (25(b)) pesticides do not require registration. Current NY pesticide registrations can be checked on the Pesticide Product, Ingredient, and Manufacturer System [PIMS website](#) (Link 2). ALWAYS CHECK WITH YOUR CERTIFIER before using a new product.

Table 11.3.9 Pesticides for Management of Gummy Stem Blight and Black Rot

Class of Compounds Product Name (Active Ingredient)	Product Rate	PHI ² (Days)	REI (Hours)	Efficacy	Comments
Badge X2 (copper hydroxide, copper oxychloride)	0.5-2.5 lb/acre	-	48	1	Rated + of ++++ in Cornell Guidelines where +/- =may be ineffective under high disease pressure; ++++ =very effective.

ORGANIC CUCUMBER & BUTTERNUT SQUASH PRODUCTION

Table 11.3.9 Pesticides for Management of Gummy Stem Blight and Black Rot					
Class of Compounds Product Name (Active Ingredient)	Product Rate	PHI² (Days)	REI (Hours)	Efficacy	Comments
Basic Copper 53 (basic copper sulfate)	2 lb/acre	up to day	24	1	See comment for Badge X2
Champ WG (copper hydroxide)	1.5-2 lb/acre	-	48	1	See comment for Badge X2
ChamplON++ (copper hydroxide)	0.5-1.25 oz/acre	0	48	?	
CS 2005 (copper sulfate pentahydrate)	19.2-25.6 oz/acre	0	48	1	See comment for Badge X2
Double Nickel 55 (<i>Bacillus amyloliquefaciens</i> strain D747)	0.25-3 lb/acre	0	4	?	
Double Nickel LC (<i>Bacillus amyloliquefaciens</i> strain D747)	0.5-6 qt/acre	0	4	?	
Nordox 75 WG (cuprous oxide)	1-1.25 lb/acre	-	12	1	See comment for Badge X2
Organic JMS Stylet-Oil (paraffinic oil)	3-6 qt/100 gal water	0	4	?	See label for sulfur and other incompatibility information.
Oxidate 2.0 (hydrogen dioxide, peroxyacetic acid)	32 fl oz - 1 gal /100 gal water	0	until dry	?	Bee Hazard. This product is toxic to bees exposed to direct contact.
Prestop (<i>Gliocladium catenulatum</i>)	3.5 oz/ 5 gal water/100 sq ft	0	0	?	Apply only when no above-ground harvestable food commodities are present.
PureSpray Green (white mineral oil)	0.75-1.5 gal/acre	up to day	4	?	
Regalia (<i>Reynoutria sachalinensis</i>)	1-4 qt/acre	0	4	?	
Serenade ASO ¹ (<i>Bacillus subtilis</i> str QST 713)	2-6 qt/acre	0	4	?	
Serenade MAX ¹ (<i>Bacillus subtilis</i> str QST 713)	1-3 lb/acre	0	4	?	
Serifel (<i>Bacillus amyloliquefaciens</i>)	4-16 oz/acre	0	4	?	

C = cucumber; WS = winter squash, PHI = pre-harvest interval, REI = re-entry interval. - = pre-harvest interval isn't specified on label.

Efficacy: 1- effective in half or more of recent university trials, 2- effective in less than half of recent university trials, 3-not effective in any known trials, ?- not reviewed or no research available. Sulfur and copper product efficacy ratings are based on trials with some but not all products. ¹Serenade Opti and Serenade ASO (labeled for foliar and soil uses) will be the only formulations in the future. Formulations may differ in efficacy, especially older and newer ones. ²Note that when the REI is longer than the PHI, Worker Protection Standard requirements may necessitate waiting until after REI to harvest

11.3.10 Plectosporium Blight, *Plectosporium tabacinum*

Time for concern: From flowering to fruit set and following, especially during periods of extended rainfall.

Affected crop(s): A rare disease on winter squash and cucumber.

Key characteristics: Light tan to “bleached”, sunken, spindle-shaped lesions, primarily on the main stems, petioles and main veins (upper and lower leaf surfaces), and spindle and/or circular lesions on fruit.

Scouting/thresholds: Begin scouting at the first sign of powdery mildew and when vines begin to run and fruit set begins. Frequent rainy periods promote infection and spread in the canopy.

Resistant varieties: Waltham winter squash is reported to have high resistance.

11.3.11 Scab - *Cladosporium cucumerinum*

Time for concern: When vines begin to run

Affected crop(s): All cucurbits

Key characteristics: The fungus can attack any aboveground portion of the plant, including leaves, petioles, stems, and fruits. On leaves, the initial pale green, water-soaked areas turn brown, are irregular in shape, and have a yellow halo around the lesion. Eventually, the center of the lesion decays, giving a “shot-holed” appearance that is very diagnostic. Lesions also develop on the fruit. A mean temperature range of 63° to 70°F with wet weather is required for spore dispersal and infection (see References 1, 4, and 11). See Cornell [fact sheet](#) (Link 55).

Scouting/thresholds: Use the following scouting method for angular leaf spot, anthracnose, scab, Septoria, and Ulocladium. As the plants begin to run, choose five representative sites. At each site, inspect two older leaves on each of five plants, for a total of 50 leaves inspected per field. Record the number of infected plants. After the row closes, substitute five plant areas. Examine ten leaves and five fruit per area. Calculate and record the percent of plants infected. Threshold: symptoms found on one leaf per 50 leaves sampled. See [Cucurbit IPM Scouting Procedures](#) (Link 62).

At the time this guide was produced, the following materials were available in New York State for managing this pest and were allowable for organic production. Listing a pest on a pesticide label does not assure the pesticide’s effectiveness. The registration status of pesticides can and does change. Pesticides must be currently registered with the New York State Department of Environmental Conservation (DEC) to be used legally in NY. However, pesticides meeting the federal requirements for minimum-risk (25(b)) pesticides do not require registration. Current NY pesticide registrations can be checked on the Pesticide Product, Ingredient, and Manufacturer System [\(PIMS\) website](#) (Link 2). ALWAYS CHECK WITH YOUR CERTIFIER before using a new product.

Table 11.3.11 Pesticides for Management of Scab					
Class of Compounds Product Name (Active Ingredient)	Product Rate	PHI ² (Days)	REI (Hours)	Efficacy	Comments
Agricure (potassium bicarbonate)	2-5 lb/acre	0	1	?	
Cueva Fungicide Concentrate (copper octanoate)	0.5-2 gal/acre	up to day	4	1	See comment for Basic Copper 53
PERpose Plus (hydrogen peroxide)	1 fl.oz./ gal initial/curative 0.25-0.33 fl.oz./ gal weekly/preventative	-	until dry	?	For initial or curative use, apply higher rate for 1 to 3 consecutive days. Then follow with weekly/preventative treatment. For weekly or preventative treatments, apply lower rate every five to seven days. At first signs of disease, use curative rate then resume weekly preventative treatment.
Prestop (<i>Gliocladium catenulatum</i>)	1.4-3.5 oz/ 2.5 gal water soil drench	0	0	?	Treat only the growth substrate when above-ground harvestable food commodities are present.
Trilogy (🐝neem oil)	0.5-1% in 25-100 gals water/A	up to day	4	?	Maximum of 2 gal/acre/application. Bee Hazard. This product is toxic to bees exposed to direct contact.

PHI = pre-harvest interval, REI = re-entry interval. - = pre-harvest interval isn't specified on label. Efficacy: 1- effective in half or more of recent university trials, 2- effective in less than half of recent university trials, 3-not effective in any known trials, ?- not reviewed or no research available. Sulfur and copper product efficacy ratings are based on trials with some but not all products. ²Note that when the REI is longer than the PHI, Worker Protection Standard requirements may necessitate waiting until after REI to harvest

🐝 Active ingredient meets EPA criteria for acute toxicity to bees

11.3.12 Sclerotinia White Mold, *Sclerotinia sclerotiorum*

Time for concern: Fruit set to end of season

Affected crop(s): Winter squash

Key characteristics: Rapid decay characterized by a watery, odorless rot and an abundance of white, cottony mold. Black, pea-sized sclerotia embedded in the cottony mycelium are diagnostic (see References 1 and 7). See Cornell [photos](#) (Link 56).


Scouting/thresholds: Record the occurrence and severity of Sclerotinia white mold. No thresholds have been established.

At the time this guide was produced, the following materials were available in New York State for managing this pest and were allowable for organic production. Listing a pest on a pesticide label does not assure the pesticide’s effectiveness. The registration status of pesticides can and does change. Pesticides must be currently registered with the New York State Department of Environmental Conservation (DEC) to be used legally in NY. However, pesticides meeting the federal requirements for minimum-risk (25(b)) pesticides do not require registration. Current NY pesticide registrations can be checked on the Pesticide Product, Ingredient, and Manufacturer System ([PIMS website](#) (Link 2)). ALWAYS CHECK WITH YOUR CERTIFIER before using a new product.

Table 11.3.12 Pesticides for Management of Sclerotinia White Mold					
Class of Compounds Product Name (Active Ingredient)	Product Rate	PHI ² (Days)	REI (Hours)	Efficacy	Comments
Actinovate AG (<i>Streptomyces lydicus</i> WYEC 108)	3-12 oz/acre	0	1 or until dry	?	Foliar spray or soil treatment.
Actinovate STP (<i>Streptomyces lydicus</i>)	4-32 oz/ cwt seed seed treatment	-	1 or until dry	?	
BIO-TAM (<i>Trichoderma asperellum</i> , <i>Trichoderma gamsii</i>)	2.5-5 lb/acre broadcast 1.5-3 1000 ft row in-furrow treatment 2.5-3 lb/acre band	-	1	?	
Bio-Tam 2.0 (<i>Trichoderma asperellum</i> , <i>Trichoderma gamsii</i>)	2.5-5 lb/acre	-	1	?	
Contans WG (<i>Coniothyrium minitans</i>)	1-4 lb/acre soil treatment	-	4	1	Effective in 1/1 trial in reducing sclerotia in the soil.
PERpose Plus (hydrogen peroxide)	1 fl oz/ gal (initial/curative) 0.25-0.33 fl oz/ gal (weekly/preventative)	-	until dry	?	For initial or curative use, apply higher rate for 1 to 3 consecutive days. Then follow with weekly/preventative treatment. For weekly or preventative treatments, apply lower rate every five to seven days. At first signs of disease, use curative rate then resume weekly preventative treatment.
Trilogy (neem oil)	0.5-1% in 25-100 gals water/A	up to day	4	?	Maximum of 2 gal/acre/application. Bee Hazard. This product is toxic to bees exposed to direct contact.

PHI = pre-harvest interval, REI = re-entry interval. . - = pre-harvest interval isn't specified on label.

Efficacy: 1- effective in half or more of recent university trials, 2- effective in less than half of recent university trials, 3-not effective in any known trials, ?- not reviewed or no research available. ²Note that when the REI is longer than the PHI, Worker Protection Standard requirements may necessitate waiting until after REI to harvest

 Active ingredient meets EPA criteria for acute toxicity to bees

11.3.13 Seed-Borne Diseases and Seed Decay

Time for concern: Seedling

Affected crop(s): All cucurbits

Key characteristics: Many seed-borne and soil-borne fungi can cause early seedling death. This can occur early in the season as damping-off or later as stem cankers.

At the time this guide was produced, the following materials were available in New York State for managing this pest and were allowable for organic production. Listing a pest on a pesticide label does not assure the pesticide’s effectiveness. The registration status of pesticides can and does change. Pesticides must be currently registered with the New York State Department of Environmental Conservation (DEC) to be used legally in NY. However, pesticides meeting the federal requirements for minimum-risk (25(b)) pesticides do not require registration. Current NY pesticide registrations can be checked on the Pesticide Product, Ingredient, and Manufacturer System ([PIMS website](#) (Link 2)). ALWAYS CHECK WITH YOUR CERTIFIER before using a new product.

Table 11.3.13 Pesticides for Management of Seed-Borne Disease and Seed Decay					
Class of Compounds Product Name (Active Ingredient)	Product Rate	PHI ² (Days)	REI (Hours)	Efficacy	Comments
Actinovate AG (<i>Streptomyces lydicus</i> WYEC 108)	3-12 oz/acre Soil treatment	0	1 or until dry	?	
BIO-TAM (<i>Trichoderma asperellum</i> , <i>Trichoderma gamsii</i>)	2.5-5 lb/acre broadcast 1.5-3 1000 ft row in-furrow treatment 2.5-3 lb/acre band	-	1	?	
Double Nickel 55 (<i>Bacillus amyloliquefaciens</i> str D747)	0.125-1 lb/acre Soil treatment	0	4	?	
Double Nickel LC (<i>Bacillus amyloliquefaciens</i> str D747)	0.5-4.5 pts/acre Soil treatment	0	4	?	
RootShield Granules (<i>Trichoderma harzianum</i>)	2.5-6 half acre in-furrow treatment	-	0	?	
RootShield PLUS+ Granules (<i>Trichoderma harzianum</i> , <i>Trichoderma virens</i>)	2.5-6 half acre in-furrow treatment	-	0	?	
RootShield PLUS+ WP (<i>Trichoderma harzianum</i> , <i>Trichoderma virens</i>)	16-32 oz/acre in-furrow treatment	0	4	?	Do not apply when above-ground harvestable food commodities are present.
RootShield WP (<i>Trichoderma harzianum</i>)	16-32 oz/acre	-	until spray dries	?	In-furrow or transplant starter solution.
Serenade Soil ¹ (<i>Bacillus subtilis</i> str QST 713)	2-6 qt/acre in-furrow treatment	0	4	?	
Taegro ECO (<i>Bacillus subtilis</i> var. <i>amyloliquefaciens</i> str. FZB2)	2.6-5.2 oz/acre	-	24	?	Drench on transplants, at planting or immediately following planting as in-furrow soil spray or with liquid fertilizer, or basal spray throughout season May be used for Rhizoctonia, Fusarium, Phytophthora and Pythium.

PHI = pre-harvest interval, REI = re-entry interval. - = pre-harvest interval isn't specified on label.

Efficacy: 1- effective in half or more of recent university trials, 2- effective in less than half of recent university trials, 3-not effective in any known trials, ?- not reviewed or no research available. ¹ Serenade Opti and Serenade ASO (labeled for foliar and soil uses) will be the only formulations in the future. Formulations may differ in efficacy, especially older and newer ones. ²Note that when the REI is longer than the PHI, Worker Protection Standard requirements may necessitate waiting until after REI to harvest

11.3.14 Septoria Leaf Spot, *Septoria cucurbitacearum*

Time for concern: June through harvest

Affected crop(s): Winter squash

Key characteristics: Spots are normally circular, beige to white with a narrow brown border, and measure 1 to 2 mm in diameter. Older spots have small, black, speck-like fruiting bodies embedded within the tissues. A mean temperature range of 58° to 64°F with wet weather is required for spore production, dispersal, and infection (see References 1, 12, and 13). See Cornell [fact sheet](#) (Link 57).

Scouting/thresholds: Use the following scouting method for angular leaf spot, anthracnose, scab, Septoria, and Ulocladium. As the plants begin to run (vine types) or flower (bush types), choose five representative sites. At each site, inspect two older leaves on each of five plants, for a total of 50 leaves inspected per field. Record the number of infected plants. After the row closes (vine types) or fruit that have set begin to enlarge (bush types), substitute five plant areas. Examine ten leaves and five fruit per area. Calculate and record the percent of plants infected. Threshold: symptoms found on one leaf per 50 leaves sampled. See [Cucurbit IPM Scouting Procedures](#) (Link 62).

At the time this guide was produced, the following materials were available in New York State for managing this pest and were allowable for organic production. Listing a pest on a pesticide label does not assure the pesticide’s effectiveness. The registration status of pesticides can and does change. Pesticides must be currently registered with the New York State Department of Environmental Conservation (DEC) to be used legally in NY. However, pesticides meeting the federal requirements for minimum-risk (25(b)) pesticides do not require registration. Current NY pesticide registrations can be checked on the Pesticide Product, Ingredient, and Manufacturer System ([PIMS website](#) (Link 2)). ALWAYS CHECK WITH YOUR CERTIFIER before using a new product.

Table 11.3.14 Pesticides for Management of Septoria Leaf Spot					
Class of Compounds Product Name (Active Ingredient)	Product Rate	PHI ² (Days)	REI (Hours)	Efficacy	Comments
Agricure (potassium bicarbonate)	2-5 lb/acre	0	1	?	
Milstop (potassium bicarbonate)	2-5 lb/acre	0	1	?	
Oxidate 2.0 (hydrogen dioxide, peroxyacetic acid)	32 fl oz - 1 gal /100 gal water	0	until dry	?	Bee Hazard. This product is toxic to bees exposed to direct contact.
Trilogy (🐝neem oil)	0.5-1% in 25-100 gals water/A	up to day	4	?	Maximum of 2 gal/acre/application. Bee Hazard. This product is toxic to bees exposed to direct contact.

PHI = pre-harvest interval, REI = re-entry interval. - = pre-harvest interval isn't specified on label.

Efficacy: 1- effective in half or more of recent university trials, 2- effective in less than half of recent university trials, 3-not effective in any known trials, ?- not reviewed or no research available. Sulfur and copper product efficacy ratings are based on trials with some but not all products. ²Note that when the REI is longer than the PHI, Worker Protection Standard requirements may necessitate waiting until after REI to harvest

🐝 Active ingredient meets EPA criteria for acute toxicity to bees

11.3.15 Ulocladium Leaf Spot

Time for concern: Mid-August into September

Affected crop(s): Cucumber

Key characteristics: Leaves develop spots with beige centers and brown rings. Lesions may also occur on the stems, but no fruit lesions occur (see Reference 1).

Scouting/thresholds: Use the following scouting method for angular leaf spot, anthracnose, scab, Septoria, and Ulocladium. As the plants begin to run, choose five representative sites. At each site, inspect two older leaves on each of five plants, for a total of 50 leaves inspected per field. Record the number of infected plants. After the row closes, substitute five plant areas. Examine ten leaves and five fruit per area. Calculate and record the percent of plants infected. Threshold: symptoms found on one leaf per 50 leaves sampled. See [Cucurbit IPM Scouting Procedures](#) (Link 62).

ORGANIC CUCUMBER & BUTTERNUT SQUASH PRODUCTION

At the time this guide was produced, the following materials were available in New York State for managing this pest and were allowable for organic production. Listing a pest on a pesticide label does not assure the pesticide's effectiveness. The registration status of pesticides can and does change. Pesticides must be currently registered with the New York State Department of Environmental Conservation (DEC) to be used legally in NY. However, pesticides meeting the federal requirements for minimum-risk (25(b)) pesticides do not require registration. Current NY pesticide registrations can be checked on the Pesticide Product, Ingredient, and Manufacturer System [\(PIMS website\)](#) (Link 2). ALWAYS CHECK WITH YOUR CERTIFIER before using a new product.

Table 11.3.15 Pesticides for Management of Ulocladium Leaf Spot					
Class of Compounds Product Name (Active Ingredient)	Product Rate	PHI ² (Days)	REI (Hours)	Efficacy	Comments
Cueva Fungicide Concentrate (copper octanoate)	0.5-2 gal/acre	up to day	4	?	
Oxidate 2.0 (hydrogen dioxide, peroxyacetic acid)	32 fl oz - 1 gal /100 gal water	0	until dry	?	Bee Hazard. This product is toxic to bees exposed to direct contact.
Trilogy (neem oil)	0.5-1% in 25-100 gals water/A	up to day	4	?	Maximum of 2 gal/acre/application. Bee Hazard. This product is toxic to bees exposed to direct contact.

PHI = pre-harvest interval, REI = re-entry interval. - = pre-harvest interval isn't specified on label, 0 = zero days to harvest
Efficacy: 1-effective in some research studies, 2- mixed efficacy results, 3-not effective, ?-not reviewed or research not available. Sulfur and copper product efficacy ratings are based on trials with some but not all products. ²Note that when the REI is longer than the PHI, Worker Protection Standard requirements may necessitate waiting until after REI to harvest

¹Active ingredient meets EPA criteria for acute toxicity to bees

11.3.16 Viruses Diseases of Cucurbits

Virus diseases of cucurbit are spread by aphids, however, the use of insecticides to kill aphid vectors is not effective for controlling these viruses. Virus incidence is lower if crop is maintained with a healthy green color as opposed to yellowing. Irrigating in dry years may help mitigate impacts of virus infection. Record the occurrence and severity of any viruses present. A list of weed and crop hosts of plant pathogenic viruses can be found in the Cornell publication, [Virus Diseases of Cucurbits](#) (Link 58). Photos of symptoms may be found at the Cornell [cucurbit virus photo gallery](#) (Link 59, References 3 and 7).

Table 11.3.16.1 Virus Diseases of Cucurbits

Disease/Symptoms	Spread by	Time for concern	Resistant Varieties	Notes
Papaya ring spot virus (PRSV). Foliar symptoms are more severe than those of WMV and some strains of CMV. Leaves show severe malformations, and extreme reduction of leaf lamina, causing a "fern-leaf" or "strap-leaf" appearance. Fruit symptoms may be severe for most cucurbits and consist of malformation, knobby outgrowths, and color breaking (see Reference 1).	Aphids	Mid-June through the end of the season	See Section 6: Varieties	Affects winter squash more often than cucumber
Watermelon mosaic virus (WMV). This virus causes milder symptoms on foliage than CMV. Mixed infections with CMV are common by the end of the season (see References 1, 4, and 14).	Aphids	Mid-June through the end of the season	See Section 6: Varieties	
Cucumber Mosaic Virus (CMV). On susceptible cucumbers, young leaves become mottled and distorted. Growth is dwarfed, and V-shaped, yellow blotches form on the older leaves. Fruit show a mosaic pattern of pale green or white areas mixed with dark green bumps. Mosaic patterns can appear on the foliage of winter squash (see References 1, 4, and 14).	Aphids	Early June through end of the season	See Section 6: Varieties	Affects winter squash more often than cucumber.

ORGANIC CUCUMBER & BUTTERNUT SQUASH PRODUCTION

Disease/Symptoms	Spread by	Time for concern	Resistant Varieties	Notes
Zucchini yellow mosaic virus (ZYMV). Extreme reduction of leaf lamina can occur as with PRSV, giving a “fern-leaf” or “strap-leaf” appearance. Fruits remain small, malformed, and green-mottled (see References 1, 4, and 14).	Aphids	Mid-June through harvest	None available	Affects winter squash more often than cucumber

PRSV=Papaya ring spot virus, CMV=Cucumber mosaic virus, WMV=Watermelon mosaic virus, ZYMV=Zucchini yellow mosaic virus.

At the time this guide was produced, the following materials were available in New York State for managing this pest and were allowable for organic production. Listing a pest on a pesticide label does not assure the pesticide’s effectiveness. The registration status of pesticides can and does change. Pesticides must be currently registered with the New York State Department of Environmental Conservation (DEC) to be used legally in NY. However, pesticides meeting the federal requirements for minimum-risk (25(b)) pesticides do not require registration. Current NY pesticide registrations can be checked on the Pesticide Product, Ingredient, and Manufacturer System [PIMS website](#) (Link 2). ALWAYS CHECK WITH YOUR CERTIFIER before using a new product.

Table 11.3.16.2 Pesticides for Management of Viruses

Class of Compounds Product Name (Active Ingredient)	Product Rate	PHI ² (Days)	REI (Hours)	Efficacy	Comments
Glacial Spray Fluid (mineral oil)	0.75-1 gal/100 gal water	up to day	4	?	
Organic JMS Stylet-Oil (paraffinic oil)	3 qt/100 gal water	0	4	?	See label for sulfur and other incompatibility information.
PureSpray Green (white mineral oil)	0.75 gal/acre	up to day	4	?	See label for specific viruses.

PHI = pre-harvest interval, REI = re-entry interval

Efficacy: 1-effective in some research studies, 2- mixed efficacy results, 3-not effective, ?-not reviewed or research not available. ²Note that when the REI is longer than the PHI, Worker Protection Standard requirements may necessitate waiting until after REI to harvest

12. NONPATHOGENIC DISORDERS

Environmental factors can cause symptoms that appear to be diseases but are actually not caused by a pathogen or insect. Table 12.1 provides a list of disorders that may be confused with diseases.

Table 12.1 Nonpathogenic Disorders of Winter Squash and Cucumbers

Disorder	Affected crop(s)	Cause/Recommendation
Oedema	Winter squash	Provide a consistent level of moisture to help reduce this moisture-stress related problem.
Poor fruit set	Cucumber/Winter squash	Related to poor pollination. Also, weather dependent. Provide honeybee hives at a rate of 1 hive per 2 acres.
No female flowers	Cucumber/Winter squash	Variety or weather related.
Misshapen fruit	Cucumber	Poor pollination or water management during fruit enlargement.
Fruit hollows	Cucumber	Good water management during fruit enlargement is essential.

13. INSECT MANAGEMENT

Effective insect management relies on accurate identification of pests and beneficial insects, an understanding of their biology and life cycle, knowledge of economically important levels of pest damage, and a familiarity with the effectiveness of allowable control

practices, in other words, Integrated Pest Management (IPM).

Regular scouting and accurate pest identification are essential for effective insect management. Thresholds used for conventional production may not be useful for organic systems because of the typically lower percent mortality and shorter residual of control products allowed for organic production. The use of pheromone traps or other

ORGANIC CUCUMBER & BUTTERNUT SQUASH PRODUCTION

monitoring and prediction techniques can provide an early warning for pest problems, and help effectively focus scouting efforts.

The contribution of crop rotation as an insect management strategy is highly dependent on the mobility of the pest. Crop rotation tends to make a greater impact on reducing pest populations if the pest has limited mobility. In cases where the insects are highly mobile, leaving a greater distance between past and present plantings is better.

Natural Enemies

Learn to identify naturally occurring beneficial insects, and attract and conserve them in your fields by providing a wide variety of flowering plants in or near the field and by avoiding use of broad-spectrum insecticides during periods when natural enemies are present. In most cases, a variety of natural enemies are present in the field, each helping to reduce pest populations. The additive effects of multiple species of natural enemies, attacking different host stages, is more likely to make an important contribution to reducing pest populations than individual natural enemy species operating alone. Natural enemies need a reason to be present in the field, either a substantial pest population, alternative hosts, or a source of pollen or nectar, and may not respond to a buildup of pests quickly enough to keep

pest populations below damaging levels. Releasing insectary-reared beneficial organisms into the crop early in the pest outbreak may help control some pests but sometimes these biocontrol agents simply leave the area. For more information, see Cornell's [Natural Enemies of Vegetable Insect Pests](#) (Reference 16) and [A Guide to Natural Enemies in North America](#) (Link 60).

Regulatory

Organic farms must comply with all other regulations regarding pesticide applications. See Section 10 for details. ALWAYS check with your organic farm certifier when planning pesticide applications.

Efficacy

In general, insecticides allowed for organic production kill a smaller percentage of the pest population and have a shorter residual than non-organic insecticides. University-based efficacy testing is not available for many organic pesticides. See Section 10.3 for more information on application techniques that can optimize effectiveness.

Resources:

[Natural Enemies of Vegetable Insect Pests](#) (Reference 16)
[Biological Control: A Guide to Natural Enemies in North America](#) (Link 60).
[Resource Guide for Organic Insect and Disease Management](#) (Link 5)

Table 13.0 Products for Insect Control in Organic Cucumbers and Winter Squash

CLASS OF COMPOUND Product Trade Name (<i>Common name</i>)	Aphids	Spider Mites	Seedcorn Maggot	Squash Bug	Squash Vine Borer	Striped and Spotted Cucumber Beetle
MICROBIALS						
Agree (<i>Bacillus thuringiensis subspecies aizawai str. GC-91</i>)					X	
Entrust (<i>spinosad</i>)					X	
Grandevo (<i>Chromobacterium subtsugae str. PRAA4-1</i>)	X	X				
PFR-97 20% WDG (<i>Isaria fumosorosea Apopka str. 97</i>)	X	X			X	
Preferal (<i>Isaria fumosorosea Apopka str. 97</i>)	X	X			X	
BOTANICALS						
Aza-Direct (<i>azadirachtin</i>)	X	X	X	X	X	X
AzaGuard (<i>azadirachtin</i>)	X	X		X	X	X
AzaMax (<i>azadirachtin</i>)	X	X		X	X	X
AzaSol (<i>azadirachtin</i>)	X		X	X	X	X
Azatrol EC (<i>azadirachtin</i>)	X	X		X	X	X
Azera (<i>azadirachtin</i>)	X	X		X	X	X

ORGANIC CUCUMBER & BUTTERNUT SQUASH PRODUCTION

CLASS OF COMPOUND Product Trade Name (Common name)	Aphids	Spider Mites	Seedcorn Maggot	Squash Bug	Squash Vine Borer	Striped and Spotted Cucumber Beetle
BioLink (<i>garlic juice</i>)	X	X			X	X
BioLink Insect & Bird Repellant (<i>garlic juice</i>)	X	X			X	X
Ecozin Plus 1.2% ME (☞ <i>azadirachtin</i>)	X		X	X	X	X
Envirepel 20 (<i>garlic juice</i>)	X	X			X	X
Garlic Barrier AG+ (<i>garlic juice</i>)	X	X				X
Molt-X (☞ <i>azadirachtin</i>)	X			X	X	X
Neemix 4.5 (☞ <i>azadirachtin</i>)	X			X	X	
PyGanic EC 5.0 _{II} (☞ <i>pyrethrins</i>)	X	X		X	X	X
PyGanic EC 1.4 _{II} (☞ <i>pyrethrins</i>)	X	X		X	X	X
Safer Brand #567 (☞ <i>pyrethrin & potassium salts of fatty acids</i>)	X	X			X	X
OILS						
BioRepel (<i>garlic oil</i>)	X					
Cedar Gard (<i>cedar oil</i>)						X
Cinnerate (<i>cinnamon oil</i>)		X				
Ecotec (<i>rosemary and peppermint oil</i>)	X	X		X	X	X
GC-Mite (<i>cottonseed, clove, and garlic oil</i>)	X	X				
Glacial Spray Fluid (<i>mineral oil</i>)	X	X				X
GrasRoots (<i>cinnamon oil</i>)	X	X				
Oleotrol-I (<i>soybean oil</i>)	X	X				
Omni Supreme Spray (<i>mineral oil</i>)	X	X			X	X
Organic JMS Stylet Oil (<i>paraffinic oil</i>)		X				
Organocide 3-in-1 (<i>sesame oil</i>)	X	X				
PureSpray Green (<i>mineral oil</i>)	X	X			X	
SuffOil-X (<i>petroleum oil</i>)	X	X				X
Trilogy (☞ <i>neem extract</i>)	X	X				
TriTek (<i>mineral oil</i>)	X	X				X
OTHER						
DES-X (<i>insecticidal soap</i>)	X	X		X		
M-Pede (<i>potassium salts of fatty acids</i>)	X	X		X		
Nuke Em (<i>citric acid</i>)	X	X				
Sil-Matrix (<i>potassium silicate</i>)	X	X				
Surround WP (<i>kaolin clay</i>)						X

☞ Active ingredient meets EPA criteria for acute toxicity to bees

13.1 Aphids, primarily the melon aphid, *Aphis gossypii*

Time for concern: When runners are present

Affected crop(s): All cucurbits

ORGANIC CUCUMBER & BUTTERNUT SQUASH PRODUCTION

Key characteristics: Melon aphids vary in color, but all stages have black cornicles, “tail pipes,” eyes, and leg joints. They are about 1/16 inch long. See Cornell [fact sheet](#) for photo (Link 61).

Transmission of viruses: Aphids are vectors of viruses. See Section 10.3.16: Viruses for symptoms and management of these diseases. Where possible, eliminate virus host plants such as pokeweed, burdock, and other perennial broadleaf weeds.

Direct damage: Aphid infestations usually occur on the undersides of leaves where they extract plant sap with their sucking/piercing mouthparts. Infested leaves will twist, pucker, or cup. Heavy infestations can cause severe leaf distortion. Aphids excrete honeydew which gives leaves a glossy appearance. Sooty mold may buildup on honeydew resulting in cosmetic damage to fruit at harvest (see References 1 and 15).

Management Option	Recommendations for Aphids
Scouting/thresholds	Aphids are found on the undersides of leaves. Examine two runners at five sites. Record the number of runners with aphids present. If more than 20 percent of the runners have live aphids, treatment may be required. Careful examination of infestations should show the presence of a variety of natural enemies including lady beetles, syrphids, lacewings, and mummified aphids (those parasitized by wasps). See Cucurbit IPM Scouting Procedures (Link 62).
Natural enemies	Naturally occurring predators, parasitoids, and pathogens help suppress aphid infestations. Use Reference 16 or see Cornell guide to natural enemies (Link 60). Increases in aphid infestations are sometimes associated with applications of insecticides that have killed natural enemies. Natural enemies will not kill aphids in time to prevent the spread of viruses.
Resistant varieties	Planting resistant varieties is the primary means of controlling aphid-transmitted viruses. Section 6: Varieties.
Site selection	Plant later season fields as far away from existing cucurbits as possible.
Mulches	Where feasible, reflective mulches may repel aphids. Direct seeding through the foil is recommended for maximum protection.
Crop rotation, Postharvest, Sanitation	These are not currently viable management options.
Notes	Hot, dry weather can cause melon aphid populations to rapidly increase. If scouting indicates localized infestations, spot spraying should be considered. Good coverage is critical for control of aphid infestations with insecticides.

At the time this guide was produced, the following materials were available in New York State for managing this pest and were allowable for organic production. Listing a pest on a pesticide label does not assure the pesticide’s effectiveness. The registration status of pesticides can and does change. Pesticides must be currently registered with the New York State Department of Environmental Conservation (DEC) to be used legally in NY. However, pesticides meeting the federal requirements for minimum-risk (25(b)) pesticides do not require registration. Current NY pesticide registrations can be checked on the Pesticide Product, Ingredient, and Manufacturer System [\(PIMS\) website](#) (Link 2). ALWAYS CHECK WITH YOUR CERTIFIER before using a new product.

Table 13.1 Pesticides for Management of Aphids					
Class of Compounds Product Name (Active Ingredient)	Product Rate	PHI ² (Days)	REI (Hours)	Efficacy	Comments
Aza-Direct (azadirachtin)	1-2 pts/acre	0	4	1	Azadirachtin based products effective in 3/4 trials. May be tank mixed at rates as low as 4 oz/A. Maximum rate is 3.5 pt/A under extremely heavy pest pressure.
AzaGuard (azadirachtin)	10-16 oz/acre	0	4	1	Azadirachtin based products effective in 3/4 trials. Apply with OMRI approved spray oil.

ORGANIC CUCUMBER & BUTTERNUT SQUASH PRODUCTION

Table 13.1 Pesticides for Management of Aphids					
Class of Compounds Product Name (Active Ingredient)	Product Rate	PHI² (Days)	REI (Hours)	Efficacy	Comments
AzaMax (azadirachtin)	1.33 fl oz/ 1000ft ²	0	4	1	See comment for AzaGuard.
AzaSol (azadirachtin)	6 oz/acre	-	4	1	See comment for AzaGuard.
Azatrol-EC (azadirachtin)	0.24-0.96 fl oz/1000 ft ²	0	4	1	See comment for AzaGuard.
Azera (azadirachtin, pyrethrins)	1-3.5 pts/acre	-	12	1	See comment for AzaGuard.
BioLink (garlic juice)	0.5-2 qt/acre	-	-	?	25(b) pesticide. Repellant.
BioLink Insect & Bird Repellant (garlic juice)	0.5-4 qt/acre	-	-	?	25(b) pesticide. Repellant.
BioRepel (garlic oil)	1 part BioRepel: 100 parts water	-	-	2	25(b) pesticide. Plant and petroleum oil products effective in 2/5 trials against aphid species.
DES-X (insecticidal soap)	2% solution sprayed at 75- 200 gallons/acre	1/2	12	?	
Ecotec (rosemary oil, peppermint oil)	1-4 pts/acre	-	-	?	25(b) pesticide
Ecozin Plus 1.2% ME (azadirachtin)	15-30 oz/acre	0	4	1	For applications the day of harvest, crop can be harvested as soon as spray has dried. See comment for AzaGuard.
Envirepel 20 (garlic juice)	10-32 oz/acre	-	-	?	25(b) pesticide. Repellant.
Garlic Barrier AG (garlic juice)	1 gal/ /99 gal water	-	-	?	25(b) pesticide Repellant.
GC-Mite (garlic oil, clove oil, cottonseed oil)	1 gal/100 gal water	-	-	2	25(b) pesticide. Plant and petroleum oil products effective in 2/5 trials against aphid species.
Glacial Spray Fluid (mineral oil)	0.75-1 gal/100 gal water	up to day	4	2	Plant and petroleum oil products effective in 2/5 trials against aphid species. See label for specific application volumes
Grandevo (<i>Chromobacterium subtsugae</i> str. PRAA4-1)	2-3 lb/acre	0	4	?	
GrasRoots (cinnamon oil)	1 part GrasRoots: 9 parts water	-	-	?	25(b) pesticide.
Molt-X (azadirachtin)	10 oz/acre	0	4	1	See comment for AzaGuard.
M-Pede (insecticidal soap)	1-2% volume to volume	0	12	3	Soap products effective in 0/9 trials against green peach aphids. When used for green peach aphid, M-Pede must be mixed with another labeled insecticide. To provide residual control for other aphid species, use in combination with another labeled insecticide.
Neemix 4.5 (azadirachtin)	5-7 oz/acre	0	4	1	See comment for AzaGuard.

ORGANIC CUCUMBER & BUTTERNUT SQUASH PRODUCTION

Table 13.1 Pesticides for Management of Aphids

Class of Compounds Product Name (Active Ingredient)	Product Rate	PHI² (Days)	REI (Hours)	Efficacy	Comments
Nuke Em (citric acid)	1 fl oz/31 oz water to 2 fl oz/ 30 fl oz water	-	-	?	25(b) pesticide
Oleotrol-I Bio-Insecticide Concentrate (soybean oil)	43-45 fl.oz./100 gal water	-	-	2	25(b) pesticide. Plant and petroleum oil products effective in 2/5 trials against aphid species.
Omni Supreme Spray (mineral oil)	1-2 gal/acre	-	12	2	Plant and petroleum oil products effective in 2/5 trials against aphid species.
Organocide (sesame oil)	1-2 gal/100 gal water	-	-	2	25(b) pesticide Plant and petroleum oil products effective in 2/5 trials against aphid species.
PFR-97 20% WDG (Isaria fumosorosea Apopka str. 97)	1-2 lb/acre	-	4	?	Repeat applications at 3-10 day intervals to maintain control.
Preferal (Isaria fumosorosea Apopka str. 97)	14-28 oz/100 gal water	-	4	?	Greenhouse use.Repeat applications at 3-10 day intervals over 2-3 weeks or as needed to maintain control.
PureSpray Green (white mineral oil)	0.75-1.5 gal/acre	up to day	4	2	Plant and petroleum oil products effective in 2/5 trials against aphid species.
PyGanic EC 1.4 II (🐝 pyrethrins)	16-64 fl.oz./acre	until dry	12	2	Pyrethrin based products effective in 1/3 trials.
PyGanic EC 5.0 II (🐝 pyrethrins)	4.5-17 fl.oz./acre	-	12	2	Pyrethrin based products effective in 1/3 trials.
Safer Brand #567 II (potassium laurate, 🐝 pyrethrins)	1 part concentrate to 20 parts water applied at 1 gal mix/700 sq ft	until dry	12	?	
Sil-Matrix (potassium silicate)	0.5-1%	0	4	?	Apply at least 20 gallons of finished spray solution per acre.
SuffOil-X (aliphatic petroleum solvent)	1-2 gal/100 gal water	Up to day	4	2	Plant and petroleum oil products effective in 2/5 trials against aphid species.Do not mix with sulfur products.
Trilogy (🐝 neem oil)	1-2%	Up to day	4	?	Maximum of 2 gal/acre/application. Bee Hazard. This product is toxic to bees exposed to direct contact.
TriTek (mineral oil)	1-2 gal/100 gal water	Up to day	4	2	Apply as needed. Plant and petroleum oil products effective in 2/5 trials against aphid species.

PHI = pre-harvest interval, REI = re-entry interval. - = pre-harvest interval isn't specified on label.

Efficacy: 1- effective in half or more of recent university trials, 2- effective in less than half of recent university trials, 3-not effective in any known trials, ?- not reviewed or no research available. ²Note that when the REI is longer than the PHI, Worker Protection Standard requirements may necessitate waiting until after REI to harvest

🐝 Active ingredient meets EPA criteria for acute toxicity to bees

13.2 Striped and Spotted Cucumber Beetle, *Acalymma vittatum* and Spotted Cucumber Beetle, *Diabrotica undecimpunctata howardi*

Time for concern: Entire season, but especially when plants are small

Affected crop(s): Cucumber, and winter squash

Key characteristics:

Cucumber beetles: See Cornell [fact sheet](#) (Link 63). The striped cucumber beetle is 1/4 inch long with black and yellow longitudinal stripes that extend to the tip of the abdomen. The head and abdomen are black. The spotted cucumber beetle is yellow green with 12 black spots, a black thorax, and yellow abdomen. Full grown larvae are 3/8 inch long, creamy white with a dark head and “tail,” and three pairs of short legs. Larvae feed on cucurbit roots. Cucumber beetle adults aggregate on leaves and in flowers. Leaf damage may appear as shot holes in cotyledons or young leaves or leaves may be netlike. Beetles may aggregate in blossoms or feed on fruit and fruit handles. Small seedlings are very susceptible and are often killed. Once the plants attain 4-5 true leaves, they are more tolerant of beetle feeding.

Bacterial wilt: (Section 11.1.1) Cucumber beetles transmit the bacterium, *Erwinia tracheiphila*, which causes bacterial wilt. Cucumbers are the most susceptible. Wilting is most severe when plants are growing rapidly. To determine if a plant is infected, press together two freshly cut sections of a stem and slowly pull them apart. If a “stringy” sap extends between the ends, the plant has bacterial wilt (see References 1, 4, 17, 18, and 24). No rescue treatments are available once the crop is infected with bacterial wilt.

Management Option	Recommendations for Striped and Spotted Cucumber Beetles
Scouting/thresholds	<p>Scout twice a week, especially when plants have less than five leaves. Examine the undersides of cotyledons, young leaves, and stems. At each of five sites in a field, inspect five plants (one per hill). Pay special attention to field edges. Calculate the average number of beetles per plant.</p> <p>Recommended thresholds vary depending on susceptibility to bacterial wilt (Section 11.1.1). Cucumber is susceptible to bacterial wilt. If plants along the edges are heavily damaged or have ≥5 beetles per plant, an insecticide should be applied within 24 hours. Thereafter, only treat if the average number of beetles per plant is 1. See Cucurbit IPM Scouting Procedures (Link 62).</p> <p>Although young plants are most susceptible, treatment may be necessary when there are ≥5 leaves per plant; if feeding damage is apparent throughout the field; blossoms are heavily infested and being damaged during peak bloom; or young fruit are being fed upon. If feeding on mature fruit or fruit handles is noted and is a concern, treatment may also be warranted.</p>
Transplants	If possible, use transplants instead of direct seeding. They will be older when beetles arrive and therefore more tolerant, or plant later after peak beetle activity is over. Treat transplants with Surround.
Natural enemies	A variety of natural enemies may help suppress cucumber beetle infestations including tachinid flies, parasitoid wasps, and predacious nematodes. Use Reference 16 or see Cornell guide to natural enemies (Link 60) for identification of natural enemies <i>Syrphidus diabolus</i> and <i>Celatoria diabolus</i> .
Perimeter trap crop	Use of trap crops is possible for this pest but has not been researched in organic systems. Cultivars vary dramatically in their attractiveness to beetles. The inexpensive variety Dark Green Zucchini is very attractive and takes up little space. Blue Hubbard squash is also an effective trap crop that is not susceptible to bacterial wilt. A trap crop can be planted early around the perimeter of the cash crop. It is important for trap crop plants to be larger than the main crop plants. It should then be sprayed with an insecticide on a cool morning after attracting beetles. Be sure the trap crop completely encircles the main crop to gain the most benefit and discourage entry of beetles into the main crop. At low populations, sprays may not be needed. Yellow sticky cards placed in the trap or yellow mulch will enhance the attractiveness of the trap crop. Applications of Surround may reduce the attractiveness of the main crop and discourage beetle movement into the crop. Organic growers who use this technique should disk up the trap crop after the first generation beetles have disappeared to kill larvae feeding on the roots and reduce the second generation population. See more information on trap crops from the

ORGANIC CUCUMBER & BUTTERNUT SQUASH PRODUCTION

Management Option	Recommendations for Striped and Spotted Cucumber Beetles
	Connecticut IPM Program (Link 63a).
Trapping	Yellow sticky cup traps should be placed every 20 feet in the outer rows of large fields. Traps should be replaced when saturated with dust and/or beetles.
Row covers	Row covers are an expensive option that is not well suited to larger fields. They will provide protection from beetles for the first 3 to 4 weeks of the season, but they must be removed when blossoms appear to permit pollination.
Resistant varieties	The presence of cucurbitacins stimulates cucumber beetle feeding, and varieties with less cucurbitacin show less damage (see Section 6: Varieties).
Crop rotation and sanitation	Deep plowing and clean cultivation after harvest may reduce overwintering populations. Keep headlands mowed. Rotate cucurbits to distant fields to help delay infestations.
Beneficial Nematodes	Some beneficial nematodes, particularly <i>Steinernema riobravis</i> , have shown promise for management of both striped and spotted cucumber beetles. Application to the root systems of plants with early season populations will reduce, but not fully control, the following generation. Read more about their use and find suppliers at http://www.biocontrol.entomology.cornell.edu/pathogens/nematodes.php (Link 63b)
Notes	Treat hot spots if possible. Insecticide applications may be more effective if made between dusk and dawn, when the striped cucumber beetle is least active. Striped cucumber beetles colonize cucurbits and continue to build up over a two to three week period early in the season. Waiting until the field is fully colonized and at threshold before spraying with an effective insecticide will result in adequate control with one or two applications. When making this decision, consideration must be given to the susceptibility of the variety to bacterial wilt (see Section 11.1.1).

At the time this guide was produced, the following materials were available in New York State for managing this pest and were allowable for organic production. Listing a pest on a pesticide label does not assure the pesticide's effectiveness. The registration status of pesticides can and does change. Pesticides must be currently registered with the New York State Department of Environmental Conservation (DEC) to be used legally in NY. However, pesticides meeting the federal requirements for minimum-risk (25(b)) pesticides do not require registration. Current NY pesticide registrations can be checked on the Pesticide Product, Ingredient, and Manufacturer System [\(PIMS\) website](#) (Link 2). ALWAYS CHECK WITH YOUR CERTIFIER before using a new product.

Table 13.2 Pesticides for Management of Striped and Spotted Cucumber Beetles					
Class of Compounds Product Name (Active Ingredient)	Product Rate	PHI ² (Days)	REI (Hours)	Efficacy	Comments
Aza-Direct (azadirachtin)	1-2 pts/acre	0	4	3	May be tank mixed at rates as low as 4 oz/A. Maximum rate is 3.5 pt/A under extremely heavy pest pressure. Azadirachtin based products effective against beetles in 0/1 trial.
AzaGuard (azadirachtin)	8-16 oz/acre	0	4	3	Apply with OMRI approved spray oil. Azadirachtin based products effective against beetles in 0/1 trial.
AzaMax (azadirachtin)	1.33 fl oz/1000 ft ²	0	4	3	Azadirachtin based products effective against beetles in 0/1 trial.
AzaSol (azadirachtin)	6 oz/acre	-	4	3	See comment for AzaMax.
Azatrol-EC (azadirachtin)	0.29-0.96 fl oz /1000 ft ²	0	4	3	See comment for AzaMax.
Azera (azadirachtin, pyrethrins)	1-3.5 pts/acre	-	12	3	Azadirachtin based products effective against beetles in 0/1 trial. Azera effective in 0/2 recent trialson zucchini.

ORGANIC CUCUMBER & BUTTERNUT SQUASH PRODUCTION

Table 13.2 Pesticides for Management of Striped and Spotted Cucumber Beetles

Class of Compounds Product Name (Active Ingredient)	Product Rate	PHI² (Days)	REI (Hours)	Efficacy	Comments
BioLink (garlic juice)	0.5-2 qt/acre	-	-	?	25(b) pesticide. Repellant.
BioLink Insect & Bird Repellant (garlic juice)	0.5-4 qt/acre	-	-	?	25(b) pesticide. Repellant.
Cedar Gard (cedar oil)	1 qt/acre	-	-	3	25(b) pesticide. Plant and petroleum oil products effective in 0/1 trial against beetle species.
Ecotec (Rosemary oil, Peppermint oil)	1-4 pts/acre	-	-	3	25(b) pesticide. Ecotec effective in 0/1 recent trial.
Ecozin Plus 1.2% ME (azadirachtin)	15-30 oz/acre soil drench	0	4	3	For applications the day of harvest, crop can be harvested as soon as spray has dried. See comment for AzaMax.
Envirepel 20 (garlic juice)	10-32 oz/acre	-	-	?	25(b) pesticide. Repellant.
Garlic Barrier AG (garlic juice)	1 gal/ /99 gal water, appy at 10 gal/acre	-	-	?	25(b) pesticide. Repellant.
Glacial Spray Fluid (mineral oil)	0.75-1 gal/100 gal water	up to day	4	3	See label for specific application volumes. Plant and petroleum oil products effective in 0/1 trial against beetle species. Labeled for beetle larvae.
Molt-X (azadirachtin)	8 oz/acre	0	4	3	See comment for AzaMax.
Omni Supreme Spray (mineral oil)	1-2 gal/acre	-	12	3	Plant and petroleum oil products effective in 0/1 trial against beetle species. Labeled for beetle larvae.
PureSpray Green (white mineral oil)	0.75-1.5 gal/acre	up to day	4	3	Larvae only. Plant and petroleum oil products effective in 0/1 trial against beetle species.
PyGanic EC 1.4 II (pyrethrins) plus Surround WP (kaolin clay)	64 oz/acre 12.5-25 lb/acre	until dry until dry	12 12	? ?	
PyGanic EC 1.4 II (pyrethrins)	16-64 fl.oz./acre	until dry	12	1	Effective in 2/ 3 trials.
PyGanic EC 5.0 II (pyrethrins)	4.5-17 fl.oz./acre	-	12	1	Effective in 2/ 3 trials.
Safer Brand #567 II (potassium laurate, pyrethrins)	1 part concentrate to 20 parts water applied at 1 gal mix/700 sq ft	until dry	12	?	
SuffOil-X (aliphatic petroleum solvent)	1-2 gal/100 gal water	Up to day	4	3	Do not mix with sulfur products. Plant and petroleum oil products effective in 0/1 trial against beetle species. Labeled for beetle larvae.
Surround WP (kaolin clay)	12.5-50 lb/acre	up to day	4	2	Surround effective in 2/4 trials.

Table 13.2 Pesticides for Management of Striped and Spotted Cucumber Beetles

Class of Compounds Product Name (Active Ingredient)	Product Rate	PHI ² (Days)	REI (Hours)	Efficacy	Comments
TriTek (mineral oil)	1-2 gal/100 gal water	Up to day	4	3	Apply as needed. Plant and petroleum oil products effective in 0/1 trial against beetle species. Labeled for beetle larvae only.

PHI = pre-harvest interval, REI = re-entry interval. - = pre-harvest interval isn't specified on label.

Efficacy: 1- effective in half or more of recent university trials, 2- effective in less than half of recent university trials, 3- not effective in any known trials, ?- not reviewed or no research available. ²Note that when the REI is longer than the PHI, Worker Protection Standard requirements may necessitate waiting until after REI to harvest

¹Active ingredient meets EPA criteria for acute toxicity to bees

13.3 Seedcorn Maggot, *Delia platura*

Time for concern: Seed sprouting to emergence

Affected crop(s): All cucurbits

Key characteristics: Adult flies are about 1/4 inch long and gray black in color. Maggots are yellowish white. Infested seeds and other plant parts are hollowed out. Damaged plants are weak and may not develop. Stand may be poor. See University of Minnesota [fact sheet](#) (Link 64).

Management Option	Recommendations for Seedcorn Maggot
Scouting/thresholds	Areas in the field where seedling emergence is poor may indicate seedcorn maggot injury. Examine five to ten seedlings in these areas and note if heavy root feeding is apparent. Growing tips may also be destroyed. Record the percentage of plants damaged.
Natural enemies	Predators, parasitoids, and pathogens, including nematodes help suppress infestations. Use Reference 16 or see Cornell guide to natural enemies (Link 60).
Resistant varieties	No resistant varieties are available.
Planting date	Where feasible, delay planting until the first generation maggots has pupated. In New York, this is about June 21. Warmer soils will allow seedlings to germinate and grow faster, leaving less time for maggots to feed and cause injury.
Transplants	If feasible, use transplants rather than seed.
Site selection/preparation	Root maggots prefer soil with high organic matter. Do not spread manure directly before planting, and incorporate crop residues well before planting. Shallow planting and other means to speed up germination and emergence will reduce damage.

ORGANIC CUCUMBER & BUTTERNUT SQUASH PRODUCTION


At the time this guide was produced, the following materials were available in New York State for managing this pest and were allowable for organic production. Listing a pest on a pesticide label does not assure the pesticide's effectiveness. The registration status of pesticides can and does change. Pesticides must be currently registered with the New York State Department of Environmental Conservation (DEC) to be used legally in NY. However, pesticides meeting the federal requirements for minimum-risk (25(b)) pesticides do not require registration. Current NY pesticide registrations can be checked on the Pesticide Product, Ingredient, and Manufacturer System [\(PIMS\) website](#) (Link 2). ALWAYS CHECK WITH YOUR CERTIFIER before using a new product.

Table 13.3 Pesticides for Management of Seedcorn Maggot

Class of Compounds Product Name (Active Ingredient)	Product Rate	PHI ² (Days)	REI (Hours)	Efficacy	Comments
Aza-Direct (azadirachtin)	1-2 pts/acre soil drench	0	4	?	
AzaSol (azadirachtin)	6 oz/acre soil drench	-	4	?	
Ecozin Plus 1.2% ME (azadirachtin)	15-30 oz/acre soil drench	0	4	?	

PHI = pre-harvest interval, REI = re-entry interval. - = pre-harvest interval isn't specified on label.

Efficacy: 1- effective in half or more of recent university trials, 2- effective in less than half of recent university trials, 3-not effective in any known trials, ?- not reviewed or no research available. ²Note that when the REI is longer than the PHI, Worker Protection Standard requirements may necessitate waiting until after REI to harvest

 Active ingredient meets EPA criteria for acute toxicity to bees

13.4 Squash Bug, *Anasa tristis*

Time for concern: When plants develop runners through harvest

Affected crop(s): All cucurbits

Key characteristics: Adults are flat, grayish or yellowish brown, and about 5/8 inch long. The edges of the abdomen, which protrude from beneath the wings, are orange and brown striped. Eggs are reddish orange and laid in clusters on the upper leaf surface. Nymphs are pale green, but become dark, greenish gray, or brown as they mature. Young nymphs feed in clusters. Adults and nymphs feed on leaves and stems. If the infestation is severe, leaves on mature plants will appear blackened as if burned. These bugs also feed directly on developing fruit. Squash bugs are known to vector a bacterial pathogen (*Serratia marcescens*), the causal agent for cucurbit yellow vine decline. This disease has not been identified in New York but has been reported in New England. See Cornell [squash bug photos](#) and [life cycle description](#) (Links 65 and 66).

Management Option	Recommendations for Squash Bugs
Scouting/thresholds	Seedling stage: overwintering adults may attack plants. If wilting is observed, check the undersides of plants for bugs. Early flowering stage: if greater than 1 egg mass per plant, treat. Time spray to kill small nymphs (see References 3 and 19).
Indicator trap	Squash bug adults can also be detected by placing boards, 12 inches by 12 inches, between plants. Turn the boards over early in the morning and destroy aggregated bugs.
Natural Enemies	Naturally occurring predators, parasitoids, and pathogens help suppress infestations. A parasitic fly, <i>Trichopoda pennipes</i> , is very common. It lays one or more cream colored, oval eggs on the squash bug's cuticle. Parasitism rates greater than 80% have been reported. Several wasp species parasitize eggs. Use Reference 16 or see Cornell guide to natural enemies (Link 60).
Resistant varieties	Resistant varieties are not available.
Postharvest	Removal or thorough destruction of crop debris and other field trash after harvest will remove overwintering shelter for the bugs. Deep tillage will bury and kill overwintering adults.
Crop rotation	Rotate annually to a non-cucurbit crop.
Crop rotation, Site selection, Seed selection/ treatment, and sanitation	Avoid heavy mulch or no-till in susceptible varieties. Squash bugs like shelter and appear more numerous in reduced tillage or mulched crop systems. Removing shelter can help to reduce overwintering populations.

ORGANIC CUCUMBER & BUTTERNUT SQUASH PRODUCTION

Management Option	Recommendations for Squash Bugs
Notes	<p>Squash bugs are secretive and difficult to reach with insecticides. Thorough coverage is important. Insecticides should be directed against young nymphs.</p> <p>See ATTRA publication Squash Bug and Squash Vine Borer: Organic Controls (Link 69).</p> <p>See information on product efficacy at: Resource Guide for Organic Insect and Disease Management (Link 5)</p>

At the time this guide was produced, the following materials were available in New York State for managing this pest and were allowable for organic production. Listing a pest on a pesticide label does not assure the pesticide’s effectiveness. The registration status of pesticides can and does change. Pesticides must be currently registered with the New York State Department of Environmental Conservation (DEC) to be used legally in NY. However, pesticides meeting the federal requirements for minimum-risk (25(b)) pesticides do not require registration. Current NY pesticide registrations can be checked on the Pesticide Product, Ingredient, and Manufacturer System ([PIMS website](#)) (Link 2). ALWAYS CHECK WITH YOUR CERTIFIER before using a new

Table 13.4 Pesticides for Management of Squash Bug


Class of Compounds Product Name (Active Ingredient)	Product Rate	PHI² (Days)	REI (Hours)	Efficacy	Comments
Aza-Direct (azadirachtin)	1-2 pts/acre	0	4	1	May be tank mixed at rates as low as 4 oz/A. Maximum rate is 3.5 pt/A under extremely heavy pest pressure. Azadirachtin based products effective in 2/ 3 trials. Foliar spray or soil drench.
AzaGuard (azadirachtin)	10-16 oz/acre	0	4	1	Azadirachtin based products effective in 2/ 3 trials. Apply with OMRI approved spray oil.
AzaMax (azadirachtin)	1.33 fl oz/1000 ft ²	0	4	1	Azadirachtin based products effective in 2/ 3 trials.
AzaSol (azadirachtin)	6 oz/acre	-	4	1	See comment for AzaMax.
Azatrol-EC (azadirachtin)	0.24-0.96 fl oz/1000 ft ²	0	4	1	See comment for AzaMax.
Azera (azadirachtin, pyrethrins)	1-3.5 pts/acre	-	12	1	Azadirachtin based products effective in 2/ 3 trials. Azera effective in 1/1 recent trial on zucchini.
DES-X (insecticidal soap)	2% solution sprayed at 75-200 gallons/acre	1/2	12	?	
Ecotec (rosemary oil, peppermint oil)	1-4 pts/acre	-	-	3	25(b) pesticide. Ecotec effective in 0/1 recent trial.
Ecozin Plus 1.2% ME (azadirachtin)	15-30 oz/acre	0	4	1	For applications the day of harvest, crop can be harvested as soon as spray has dried. See comment for AzaMax.
Molt-X (azadirachtin)	10 oz/acre	0	4	1	See comment for AzaMax.
M-Pede (insecticidal soap)	1-2% v/v	0	12	?	Eggs and nymphs are the only susceptible stages.
Neemix 4.5 (azadirachtin)	7-16 oz/acre	0	4	1	See comment for AzaMax.
PyGanic EC 1.4 II (pyrethrins)	16-64 fl oz/acre	until dry	12	?	

Table 13.4 Pesticides for Management of Squash Bug

Class of Compounds Product Name (Active Ingredient)	Product Rate	PHI ² (Days)	REI (Hours)	Efficacy	Comments
Neemix 4.5 (azadirachtin)	16 oz/acre	0	4	?	Weekly sprays recommended, but tighter if longer egg laying period. Nymphs are the only susceptible stage.
<i>plus</i> PyGanic EC 1.4 II (pyrethrins)	32 oz/acre	until dry	4	?	Weekly sprays recommended, but tighter if longer egg laying period. Nymphs are the only susceptible stage.
PyGanic EC 5.0 II (pyrethrins)	4.5-17 fl oz/acre	-	12	?	

PHI = pre-harvest interval, REI = re-entry interval. - = pre-harvest interval isn't specified on label.

Efficacy: 1- effective in half or more of recent university trials, 2- effective in less than half of recent university trials, 3-not effective in any known trials, ?- not reviewed or no research available. ²Note that when the REI is longer than the PHI, Worker Protection Standard requirements may necessitate waiting until after REI to harvest

 Active ingredient meets EPA criteria for acute toxicity to bees

13.5 Squash Vine Borer, *Melittia cucurbitae*

Time for concern: Mid-June through August

Crops: Squash vine borer rarely affects cucumbers and butternut squash are practically immune to attack (Reference 24).

Key characteristics: The adult of the squash vine borer is a wasp-like moth having a 1 to 1½ inch wingspan, with metallic green forewings. The mature larva or caterpillar is a thick, white wrinkled worm with a brown head and is about 1 inch in length. The eggs are dull red, 1/25th inch in diameter and are found glued to the stalks and stems of squash vines. The pupa is dark brown, 5/8 inch long and found in an earthen cell. See Cornell [squash vine borer photos](#) and [life cycle description](#) (Links 67 and 68).

Management Option	Recommendations for Squash Vine Borer
Scouting/thresholds	Because larvae are protected from insecticides once they have bored into the stem, adult activity should be used to time insecticide applications where squash vine borer is a perennial problem. Adult activity may be monitored using pheromone traps or predicted using base 50° F degree-day (DD ₅₀) accumulations. The flight begins around 1000 base 50 degree-days, which coincides with the beginning of chicory flowering. Refer to the NYS IPM Program’s Network for Environment and Weather Awareness (NEWA) to calculate degree-days (Link 3).
Natural enemies	Predators, parasitoids, and pathogens, including beneficial nematodes help suppress infestations. Use Reference 16 or see Cornell guide to natural enemies (Link 60).
Resistant varieties	Both cucumber and butternut squash are at low risk of infestation.
Row Covers	Lightweight row covers can be also used to protect plants until the vines come into flower. Remove covers at bloom time to allow for pollination. However this method is best suited to small fields and is not practical or economical for larger production areas.
Rotation/Sanitation	Rotate annually to a non-cucurbit crop but keep in mind, adult squash vine borers are strong fliers and are known to have the ability to fly up to 1/2 mile from their emergence site (Link 63).
Cultural	Fall tillage exposes cocoons (pupae) to predation and deep incorporation in early spring further helps to keep populations suppressed. However leaving ground bare for the winter runs contrary to good organic practices. Consider planning a cover crop if time allows (Link 63).

ORGANIC CUCUMBER & BUTTERNUT SQUASH PRODUCTION

Sanitation	To reduce the number of borers for the next year, destroy crop residue after harvest.
Notes	<p>Application of insecticides is not currently a viable management option. Treatments could be effective if applied to the base of the plant prior to boring into the stem.</p> <p>The ATTRA publication Squash Bug and Squash Vine Borer: Organic Controls (Link 69) has more specific information on squash vine borer management.</p>

At the time this guide was produced, the following materials were available in New York State for managing this pest and were allowable for organic production. Listing a pest on a pesticide label does not assure the pesticide's effectiveness. The registration status of pesticides can and does change. Pesticides must be currently registered with the New York State Department of Environmental Conservation (DEC) to be used legally in NY. However, pesticides meeting the federal requirements for minimum-risk (25(b)) pesticides do not require registration. Current NY pesticide registrations can be checked on the Pesticide Product, Ingredient, and Manufacturer System [PIMS website](#) (Link 2). ALWAYS CHECK WITH YOUR CERTIFIER before using a new product.

Table 13.5 Pesticides for Management of Squash Vine Borer

Class of Compounds Product Name (Active Ingredient)	Product Rate	PHI ² (Days)	REI (Hours)	Efficacy	Comments
Agree WG (<i>Bacillus thuringiensis</i>)	0.5-2 lb/acre	up to day	4	1	2(ee) recommendation. http://pims.psur.cornell.edu/LabelResults.php?ProductId=170563&SearchPage=ProductName.php . Effective in 1/1 trial. Two to three insecticide treatments, 5-7 days apart during the three week egg-laying period, around 1000 DD50, will control most of the larval borers before they become protected by the vines.
Aza-Direct (azadirachtin)	1-2 pts/acre	0	4	3	May be tank mixed at rates as low as 4 oz/A. Maximum rate is 3.5 pt/A under extremely heavy pest pressure. Azadirachtin based products effective in 0/2 trials.
AzaGuard (azadirachtin)	8-16 oz/acre	0	4	3	Apply with OMRI approved spray oil. Azadirachtin based products effective in 0/2 trials.
AzaMax (azadirachtin)	1.33 fl oz/ 1000 ft ²	0	4	3	Azadirachtin based products effective in 0/2 trials.
AzaSol (azadirachtin)	6 oz/acre soil drench	-	4	3	See comment for AzaMax.
Azatrol-EC (azadirachtin)	0.24-0.96 /1000 sq ft	0	4	3	See comment for AzaMax.
Azera (azadirachtin, pyrethrins)	1-3.5 pts/acre	-	12	1	Azera effective in 1/1 recent trial.
BioLink (garlic juice)	0.5-2 qt/acre	-	-	?	25(b) pesticide. Repellant.
BioLink Insect & Bird Repellant (garlic juice)	0.5-4 qt/acre	-	-	?	25(b) pesticide. Repellant.
Ecotec (Rosemary oil, Peppermint oil)	1-4 pts/acre	-	-	?	25(b) pesticide.
Ecozin Plus 1.2% ME (azadirachtin)	15-30 oz/acre soil drench	0	4	3	For applications the day of harvest, crop can be harvested as soon as spray has dried. See comment for AzaMax.
Entrust (spinosad)	1.5-2.5 oz/acre	3 (squash) 1 (cucumber)	4	1	2(ee) recommendation http://pims.psur.cornell.edu/LabelResults.php?ProductId=170564&SearchPage=ProductName.php Effective against caterpillars in 41/47 trials. Entrust effective in 1/1 recent trial on zucchini. Two to three insecticide treatments, 5-7 days apart during the three week egg-laying period, around 1000 DD50 will control most of the larval borers before they become


ORGANIC CUCUMBER & BUTTERNUT SQUASH PRODUCTION

Table 13.5 Pesticides for Management of Squash Vine Borer

Class of Compounds Product Name (Active Ingredient)	Product Rate	PHI ² (Days)	REI (Hours)	Efficacy	Comments
					protected by the vines.
Envirepel 20 (garlic juice)	10-32 oz/acre	-	-	?	25(b) pesticide. Repellent.
Molt-X (azadirachtin)	8 oz/acre	0	4	3	See comment for AzaMax.
Neemix 4.5 (azadirachtin)	7-16 oz/acre	0	4	3	See comment for AzaMax.
Omni Supreme Spray (mineral oil)	1-2 gal/acre	-	12	1	Plant and petroleum oil products effective against caterpillars in 3/6 trials
PFR-97 20% WDG (Isaria fumosorosea Apopka str. 97)	1-2 lb/acre Soil treatment	-	4	?	Apply suspension as a 4" to 8" banded drench or coarse spray onto the soil surface in the seed furrow, or as a broadcast spray or drench onto the planting bed.
PureSpray Green (white mineral oil)	0.75-1.5 gal/acre	up to day	4	1	Plant and petroleum oil products effective against caterpillars in 3/6 trials
PyGanic EC 1.4 II (pyrethrins)	16-64 fl.oz./acre	until dry	12	?	
PyGanic EC 5.0 II (pyrethrins)	4.5-17 fl.oz./acre	-	12	?	
Safer Brand #567 II (potassium laurate, pyrethrins)	1 part concentrate to 20 parts water applied at 1 gal mix/700 sq ft	until dry	12	?	

PHI = pre-harvest interval, REI = re-entry interval. - = pre-harvest interval isn't specified on label.

Efficacy: 1- effective in half or more of recent university trials, 2- effective in less than half of recent university trials, 3-not effective in any known trials, ?- not reviewed or no research available. ²Note that when the REI is longer than the PHI, Worker Protection Standard requirements may necessitate waiting until after REI to harvest

 Active ingredient meets EPA criteria for acute toxicity to bees

13.6 Spider Mites, primarily the two-spotted spider mite, *Tetranychus urticae*

Time for concern: summer when the weather is hot and dry.

Affected crop(s): Cucumber

Key characteristics: The two-spotted spider mite is very small, 1/64 inch long, and greenish yellow with two dark spots on its back. Use a hand lens to confirm identification. Infestations occur primarily on leaf undersides. Webbing indicates presence of mites and hundreds may be present on a single leaf. Heavily infested leaves will turn yellow; undersides of infested leaves will appear crusty. See University of Florida [fact sheet with photo](#) to help identify (Link 70).

Management Option	Recommendations for Spider Mites
Scouting/thresholds	No specific scouting or threshold recommendations are available for New York. Watch for infestations as the field is scouted for aphids. Infestations often start at the edge of a field.
Natural enemies	Predatory mites, minute pirate bugs, predatory thrips, and fungal pathogens help suppress mite infestations. Use Reference 16 or see Cornell guide to natural enemies (Link 60). Insecticides applied for other pests can eliminate mite natural enemies.
Resistant varieties	Resistance is not an option for providing control.

ORGANIC CUCUMBER & BUTTERNUT SQUASH PRODUCTION

Management Option	Recommendations for Spider Mites
Site selection	Avoid planting in areas where dust occurs, such as near dirt roads.
Crop rotation, Seed selection/ treatment, Postharvest, & Sanitation	These are not currently viable management options.
Notes	The problem is worse when the weather is hot and dry. Rains can reduce infestations.

At the time this guide was produced, the following materials were available in New York State for managing this pest and were allowable for organic production. Listing a pest on a pesticide label does not assure the pesticide’s effectiveness. The registration status of pesticides can and does change. Pesticides must be currently registered with the New York State Department of Environmental Conservation (DEC) to be used legally in NY. However, pesticides meeting the federal requirements for minimum-risk (25(b)) pesticides do not require registration. Current NY pesticide registrations can be checked on the Pesticide Product, Ingredient, and Manufacturer System [\(PIMS\) website](#) (Link 2). ALWAYS CHECK WITH YOUR CERTIFIER before using a new product.


Table 13.6 Pesticides for Management of Mites					
Class of Compounds Product Name (Active Ingredient)	Product Rate	PHI ² (Days)	REI (Hours)	Efficacy	Comments
Aza-Direct (azadirachtin)	1-2 pts/acre	0	4	?	May be tank mixed at rates as low as 4 oz/A. Maximum rate is 3.5 pt/A under extremely heavy pest pressure.
AzaGuard (azadirachtin)	10-16 oz/acre	0	4	?	Apply with OMRI approved spray oil.
AzaMax (azadirachtin)	1.33 fl oz/1000 ft ²	0	4	?	
Azatrol-EC (azadirachtin)	0.24-0.96 fl oz/1000 ft ²	0	4	?	
Azera (azadirachtin, pyrethrins)	1-3.5 pts/acre	-	12	?	
BioLink (garlic juice)	0.5-2 qt/acre	-	-	?	25(b) pesticide. Repellant.
BioLink Insect & Bird Repellant (garlic juice)	0.5-4 qt/acre	-	-	?	25(b) pesticide. Repellant.
Cinnerate (cinnamon oil)	13-30 fl.oz./100 gal water	-	-	?	25(b) pesticide
DES-X (insecticidal soap)	2% solution sprayed at 75-200 gallons/acre	1/2	12	?	
Ecotec (rosemary oil, peppermint oil)	1-4 pts/acre	-	-	?	25(b) pesticide
Envirepel 20 (garlic juice)	10-32 oz/acre	-	-	?	25(b) pesticide. Repellant.
Garlic Barrier AG (garlic juice)	1 gal/ /99 gal water, apply at 10 gal/acre	-	-	?	25(b) pesticide. Repellant.
GC-Mite (garlic oil, clove oil, cottonseed oil)	1 gal/100 gal water	-	-	1	25(b) pesticide. Plant and petroleum oil products effective in 1/1 trial.
Glacial Spray Fluid (mineral oil)	0.75-1 gal/100 gal water	up to day	4	1	See label for specific application volumes. Plant and petroleum oil products effective in 1/1 trial.
Grandevo (<i>Chromobacterium subsugae</i> str. PRAA4-1)	2-3 lb/acre	0	4	?	
GrasRoots (cinnamon oil)	1 part GrasRoots to 9 parts water	-	-	?	25(b) pesticide.

ORGANIC CUCUMBER & BUTTERNUT SQUASH PRODUCTION

Table 13.6 Pesticides for Management of Mites					
Class of Compounds Product Name (Active Ingredient)	Product Rate	PHI² (Days)	REI (Hours)	Efficacy	Comments
M-Pede (insecticidal soap)	1-2% v/v	0	12	1	Soap products effective in 2/3 trials.
Nuke Em (citric acid)	1 fl oz/31 oz water to 2 fl oz/ 30 fl oz water	-	-	?	25(b) pesticide
Oleotrol-I Bio-Insecticide Concentrate (soybean oil)	43-45 fl oz/100 gal water	-	-	1	25(b) pesticide. Plant and petroleum oil products effective in 1/1 trial.
Omni Supreme Spray (mineral oil)	1-2 gal/acre	-	12	1	Plant and petroleum oil products effective in 1/1 trial.
Organic JMS Stylet-Oil (paraffinic oil)	3-6 qt/100 gal water	0	4	1	Plant and petroleum oil products effective in 1/1 trial.
Organocide (sesame oil)	1-2 gal/100 gal water	-	-	1	25(b) pesticide. See comment for Organic JMS Stylet-Oil.
PFR-97 20% WDG (<i>Isaria fumosorosea</i> Apopka str. 97)	1-2 lb/acre	-	4	?	
Preferal (<i>Isaria fumosorosea</i> Apopka str. 97)	14-28 oz/100 gal water	-	4	?	Greenhouse use.
PureSpray Green (white mineral oil)	0.75-1.5 gal/acre	up to day	4	1	See comment for Organic JMS Stylet-Oil.
PyGanic EC 1.4 II (pyrethrins)	16-64 fl.oz./acre	until dry	12	?	
PyGanic EC 5.0 II (pyrethrins)	4.5-17 fl.oz./acre	-	12	?	
Safer Brand #567 II (potassium laurate, pyrethrins)	1 part concentrate to 20 parts water applied at 1 gal mix/700 sq ft	until dry	12	?	
Sil-Matrix (potassium silicate)	0.5-1%	0	4	?	Apply at least 20 gallons of finished spray solution per acre.
SuffOil-X (aliphatic petroleum solvent)	1-2 gal/100 gal water	Up to day	4	1	Do not mix with sulfur products. See comment for PureSpray Green.
Trilogy (neem oil)	0.5-1%	up to day	4	?	Maximum of 2 gal/acre/application. Bee Hazard. This product is toxic to bees exposed to direct contact.
TriTek (mineral oil)	1-2 gal/100 gal water	Up to day	4	1	See comment for Organic JMS Stylet-Oil.



PHI = pre-harvest interval, REI = re-entry interval. - = pre-harvest interval isn't specified on label.

Efficacy: 1- effective in half or more of recent university trials, 2- effective in less than half of recent university trials, 3-not effective in any known trials, ?- not reviewed or no research available. ²Note that when the REI is longer than the PHI, Worker Protection Standard requirements may necessitate waiting until after REI to harvest

 Active ingredient meets EPA criteria for acute toxicity to bees

14. PESTICIDES & ABBREVIATIONS MENTIONED IN THIS PUBLICATION

Table 14.1 Insecticides and Nematicides

TRADE NAME	COMMON NAME	EPA REG. NO.
Agree WG	<i>Bacillus thuringiensis subspecies aizawai</i>	70051-47
Aza-Direct	 azadirachtin	71908-1-10163
AzaGuard	 azadirachtin	70299-17

ORGANIC CUCUMBER & BUTTERNUT SQUASH PRODUCTION

Table 14.1 Insecticides and Nematicides

TRADE NAME	COMMON NAME	EPA REG. NO.
AzaMax	azadirachtin	71908-1-81268
AzaSol	azadirachtin	81899-4
Azatrol EC	azadirachtin	2217-836
Azera	azadirachtin	1021-1872
BioLink	garlic juice	exempt - 25(b) pesticide
BioLink Insect & Bird Repellant	garlic juice	exempt - 25(b) pesticide
BioRepel	garlic oil	exempt - 25(b) pesticide
Cedar Gard	cedar oil	exempt - 25(b) pesticide
Cinnerate	cinnamon oil	exempt - 25(b) pesticide
DES-X	insecticidal soap	67702-22-70051
DiTera DF	Myrothecium verrucaria	73049-67
Ecotec	rosemary and peppermint oil	exempt - 25(b) pesticide
Ecozin Plus 1.2% ME	azadirachtin	5481-559
Entrust	spinosad	62719-282
Envirepel 20	garlic juice	exempt - 25(b) pesticide
Garlic Barrier AG+	garlic juice	exempt - 25(b) pesticide
GC-Mite	cottonseed, clove, and garlic oil	exempt - 25(b) pesticide
Glacial Spray Fluid	mineral oil	34704-849
Grandevo	Chromobacterium subtsugae str. PRAA4-1	84059-17
GrasRoots	cinnamon oil	exempt - 25(b) pesticide
MeloCon WG	Paecilomyces lilacinus str. 251	72444-2
Molt-X	azadirachtin	68539-11
M-Pede	potassium salts of fatty acids	10163-324
Neemix 4.5	azadirachtin	70051-9
Nuke Em	citric acid	exempt - 25(b) pesticide
Oleotrol-I	soybean oil	exempt - 25(b) pesticide
Omni Supreme Spray	mineral oil	5905-368
Organic JMS Stylet oil	paraffinic oil	65564-1
Organocide 3-in-1	sesame oil	exempt - 25(b) pesticide
PFR-97 20% WDG	Isaria fumosorosea Apopka str. 97	70051-19
Preferal	Isaria fumosorosea Apopka str. 97	70051-19-67690
PureSpray Green	mineral oil	69526-9
PyGanic EC 1.4II	pyrethrin	1021-1771
PyGanic EC 5.0II	pyrethrin	1021-1772
Safer Brand #567	pyrethrin & potassium salts of fatty acids	59913-9
Serifel	(Bacillus amyloliquefaciens)	71840-18
Sil-Matrix	potassium silicate	82100-1
SuffOil-X	aliphatic petroleum solvent	48813-1-68539
Surround WP	kaolin	61842-18
Trilogy	neem oil	70051-2
TriTek	mineral oil	48813-1

Table 14.2 Fungicides

TRADE NAME	COMMON NAME	EPA REG. NO.
Acoidal	Sulfur	62562-4
Actinovate AG	Streptomyces lydicus WYEC 108	73314-1
Actinovate STP	Streptomyces lydicus WYEC 108	73314-4
Agricure	Potassium bicarbonate	70870-1
Badge X2	copper oxychloride, copper hydroxide	80289-12
Basic Copper 53	copper sulfate	45002-8
BIO-TAM	Trichoderma asperellum, Trichoderma gamsii	80289-9-69592
BIO-TAM 2.0	Trichoderma asperellum, Trichoderma gamsii	80289-9
Champ WG	copper hydroxide	55146-1
Champion++	copper hydroxide	55146-115
Contans WG	Coniothyrium minitans	72444-1
CS 2005	copper sulfate pentahydrate	66675-3

ORGANIC CUCUMBER & BUTTERNUT SQUASH PRODUCTION

Table 14.2 Fungicides

TRADE NAME	COMMON NAME	EPA REG. NO.
Cueva Fungicide Concentrate	<i>copper octanoate</i>	67702-2-70051
Defend DF	<i>Sulfur</i>	62562-8
Double Nickel 55 Biofungicide	<i>Bacillus amyloliquefaciens strain D747</i>	70051-108
Double Nickel LC Biofungicide	<i>Bacillus amyloliquefaciens strain D747</i>	70051-107
Glacial Spray Fluid	<i>mineral oil</i>	34704-849
GrasRoots	<i>cinnamon oil</i>	exempt – 25(b) pesticide
Kaligreen	<i>potassium bicarbonate</i>	11581-2
M-Pede	<i>potassium salts of fatty acids</i>	10163-324
Milstop	<i>potassium bicarbonate</i>	70870-1-68539
Micro Sulf	<i>Sulfur</i>	55146-75
Microthiol Disperss	<i>sulfur</i>	70506-187
Mildew Cure	<i>cottonseed oil, corn oil, garlic oil</i>	exempt – 25(b) pesticide
Mycostop Biofungicide	<i>Streptomyces griseoviridis</i>	64137-5
Mycostop Mix	<i>Streptomyces griseoviridis</i>	64137-9
Nordox 75 WG	<i>cuprous oxide</i>	48142-4
Nu-Cop 50DF	<i>cuprous hydroxide</i>	45002-4
Nu-Cop 50 WP	<i>cupric hydroxide</i>	45002-7
Nu-Cop HB	<i>cupric hydroxide</i>	42750-132
Nuke Em	<i>citric acid</i>	exempt - 25(b) pesticide
Organic JMS Stylet oil	<i>paraffinic oil</i>	65564-1
Organocide 3-in-1	<i>sesame oil</i>	exempt – 25(b) pesticide
OxiDate 2.0	<i>hydrogen dioxide, peroxyacetic acid</i>	70299-12
PERpose Plus	<i>hydrogen peroxide/dioxide</i>	86729-1
PureSpray Green	<i>mineral oil</i>	69526-9
Prestop Biofungicide WP	<i>Gliocladium catenulatum</i>	64137-11
Regalia Biofungicide	<i>Reynoutria sachalinensis</i>	84059-3
RootShield Granules	<i>Trichoderma harzianum Rifai str. T-22</i>	68539-3
RootShield PLUS+ Granules	<i>Trichoderma harzianum str. T-22, Trichoderma virens str. G-41</i>	68539-10
RootShield PLUS+ WP	<i>Trichoderma harzianum str. T-22, Trichoderma virens str. G-41</i>	68539-9
RootShield WP	<i>Trichoderma harzianum str. T-22 (KRL-AG2)</i>	68539-7
Serenade ASO	<i>Bacillus subtilis str QST 713</i>	69592-12 and 264-1152
Serenade MAX	<i>Bacillus subtilis str QST 713</i>	69592-11 and 264-1151
Serenade Soil	<i>Bacillus subtilis str QST 713</i>	69592-12 and 264-1152
Sil-Matrix	<i>potassium silicate</i>	82100-1
SoilGard	<i>Gliocladium virens str. GL-21</i>	70051-3
SuffOil-X	<i>aliphatic petroleum solvent</i>	48813-1-68539
Surround WP	<i>kaolin</i>	61842-18
Taegro Biofungicide	<i>Bacillus subtilis</i>	70127-5
Taegro ECO	<i>(Bacillus subtilis var. amyloliquefaciens str. FZB24)</i>	70127-5-100
TerraClean 5.0	<i>(hydrogen dioxide, peroxyacetic acid)</i>	70299-13
Thiolux	<i>sulfur</i>	34704-1079
Trilogy	<i>neem oil</i>	70051-2
TriTek	<i>mineral oil</i>	48813-1
Zonix	<i>rhamnolipid biosurfactant</i>	72431-1

Abbreviations and Symbols Used in This Publication

A	acre	NI	no information
AG	agricultural use label	NFT	not frost tolerant
AR	annual rye	P	phosphorus
ASO	aqueous suspension-organic	PHI	pre-harvest interval
AS	aqueous suspension	P ₂ O ₅	phosphorus oxide
C	cucumber	PR	perennial rye
CMV	cucumber mosaic virus	PRSV	papaya ring spot virus
DF	dry flowable	R	resistant varieties
EC	emulsifiable concentrate	REI	restricted entry interval
F	flowable	WS	winter squash
HC	high concentrate	WMV	watermelon mosaic virus
K	potassium	WP	wettable powder
K ₂ O	potassium oxide	WPS	Worker Protection Standard
N	nitrogen	WG	water dispersible granular
NE	not effective	ZYMV	zucchini yellow mosaic virus

15. REFERENCES

- Zitter, T. A., Hopkins, D. L. and Thomas, C. E. (1996). Compendium of Cucurbit Diseases (pp 87). American Phytopathological Society Press.
- Zitter, T. A. (1992). Assorted foliar diseases of cucurbits, In *Vegetable Crops: Diseases of Cucurbits* (p. 732.90). New York State Agricultural Experiment Station, Geneva, NY.
- Zitter, T. A., Hoffmann, M. P., McGrath M. T., Petzoldt, C. H., Seaman, A. J., and Pederson, L. H. eds. (1996) Cucurbit IPM Scouting Procedures for New York IPM, Publication 113. New York State Agricultural Experiment Station, Geneva, NY (<http://www.nysipm.cornell.edu/scouting/scoutproc/cuke00.asp>).
- Cornell Cooperative Extension (1983-1997). Cucurbit fact sheet set (pp. 732.10, 732.30, 732.40, 732.50, 732.60, 780.00, and 781.00). In *Vegetable Crops: Diseases of Cucurbits*. New York State Agricultural Experiment Station, Geneva, NY.
- Zitter, T. A. (1987). Anthracnose of cucurbits (p. 732.60). In *Vegetable Crops: Diseases of Cucurbits*. Cornell Cooperative Extension. New York State College of Agriculture and Life Sciences, Ithaca, NY.
- Zitter, T. A. (1998). Fusarium diseases of cucurbits (p. 733.00). In *Vegetable Crops: Diseases of Cucurbits*. New York State Agricultural Experiment Station, Geneva, NY.
- Zitter, T. A. (1992). Fruit rots of squash and pumpkins (p. 732.10) In *Vegetable Crops: Diseases of Cucurbits*. New York State Agricultural Experiment Station, Geneva, NY.
- Zitter, T. A. (1992). Gummy stem blight of cucurbits (p. 732.70). In *Vegetable Crops: Diseases of Cucurbits*. Cornell Cooperative Extension. New York State College of Agriculture and Life Sciences, Ithaca, NY.
- Zitter, T. A. (1989). Phytophthora blight of peppers and certain other vegetables (p. 736.20). In *Vegetable Crops: Diseases of Peppers*. Cornell Cooperative Extension. New York State College of Agriculture and Life Sciences, Ithaca, NY.
- McGrath, M. T. (1997). Powdery mildew of cucurbits (p. 732.30). In *Vegetable Crops: Diseases of Cucurbits*. New York State Agricultural Experiment Station, Geneva, NY.
- Zitter, T. A. (1986). Scab of cucurbits (p. 732.50). In *Vegetable Crops: Diseases of Cucurbits*. Cornell Cooperative Extension. New York State College of Agriculture and Life Sciences, Ithaca, NY.
- Cornell Cooperative Extension (1992-1993). Cucurbits fact sheet set (pp. 732.70, 732.80, 732.90, and 750.50). In *Vegetable Crops: Diseases and Insects of Cucurbits*. New York State Agricultural Experiment Station, Geneva, NY.
- Zitter, T. A. (1992). Septoria leaf and fruit spot of cucurbits (p. 732.80). In *Vegetable Crops: Diseases of Cucurbits*. New York State Agricultural Experiment Station, Geneva, NY.
- Zitter, T. A., Banik, M. T. and Provvidenti, R. (1984). Virus diseases of cucurbits, (p. 732.40). In *Vegetable Crops: Diseases of Cucurbits*. Cornell Cooperative Extension. New York State College of Agriculture and Life Sciences, Ithaca, NY.
- Hoffmann, M. P., and Sanderson, J. (1993). Melon aphid (p. 750.50). In *Vegetable Crops: Insects of Cucurbits*. Cornell Cooperative Extension. New York State College of Agriculture and Life Sciences, Ithaca, NY.
- Hoffmann, M. P., and Frodsham, A. C. (1993). Natural Enemies of Vegetable Insect Pests. Cornell Cooperative Extension, Ithaca, NY.

ORGANIC CUCUMBER & BUTTERNUT SQUASH PRODUCTION

17. Muka, A. A. (1983). Striped cucumber beetle (p. 780.00). In *Vegetable Crops: Insects of Cucurbits*. New York State Agricultural Experiment Station, Geneva, NY.
18. Hoffmann, M. P., and Zitter, T. A. (1994). Cucumber beetles, corn rootworms, and bacterial wilt in cucurbits, (p. 781.00). In *Vegetable Crops: Insects of Cucurbits*. New York State Agricultural Experiment Station, Geneva, NY.
19. Foster, R., and Flood, B. eds. (1995). *Vegetable Insect Management: With Emphasis on the Midwest*. Meister, Willoughby, Ohio.
20. Pennsylvania State University. (1987). *Weed identification* (pp. 1-32). Pennsylvania State University Cooperative Extension, University Park, PA.
21. Sarrantonio, M. (1994) *Northeast Cover Crop Handbook*, Rodale Institute, PA. (can be purchased at <http://rodaleinstitute.org/shop/northeast-cover-crop-handbook/>)
22. Babadoost, M. (2006) University of Illinois. *New Strategies for Management of Vegetable Diseases in Organic and Traditional Farms*. (<http://mysare.sare.org/mySARE/ProjectReport.aspx?do=viewRept&pn=LNC03-228&y=2006&t=1>).
23. Stivers, L.J., Brainard, D.C. Abawi, G.S., Wolfe, D.W. (1999) *Cover Crops for Vegetable Production in the Northeast*. Cornell Cooperative Extension, Ithaca, NY <http://ecommons.cornell.edu/bitstream/1813/3303/2/Cover%20Crops.pdf>).

16. WORLD WIDE WEB LINKS

All links accessed 27 April 2016.

General

1. New York State Integrated Pest Management Program, *Integrated Crop and Pest Management Guidelines for Commercial Vegetable Production (2013): Chapter 18, Cucurbits*. Cornell Cooperative Extension, Geneva, NY. (<https://ipmguidelines.org/>)
2. *Pesticide Product Ingredient and Manufacturer System (PIMS)*. (<http://pims.psur.cornell.edu/index.php>)
3. The Network for Environment and Weather Awareness (NEWA). New York State Integrated Pest Management Program. (<http://newa.cornell.edu/>)
4. Wilsey, W.T., Weeden, C.R., Shelton, A.M., Pests in the Northeastern United States, (<http://web.entomology.cornell.edu/shelton/veg-insects-ne/>).
5. *Resource Guide for Organic Insect and Disease Management*. New York State Agricultural Experiment Station, Geneva, NY. (<http://web.pppmb.cals.cornell.edu/resourceguide/pdf/resource-guide-for-organic-insect-and-disease-management.pdf>)

Certification

6. Organic Materials Review Institute. (<http://www.omri.org/>) Adjuvants. [http://www.omri.org/uberserach/results/adjuvant?type\[\]=opd_listed_product&type\[\]=opd_prohibited_product&type\[\]=opd_removed_product&cl\[\]=16997&rb\[\]=17013](http://www.omri.org/uberserach/results/adjuvant?type[]=opd_listed_product&type[]=opd_prohibited_product&type[]=opd_removed_product&cl[]=16997&rb[]=17013)
7. New York Department of Agriculture and Markets, *Organizations Providing Organic Certification Services for Producers and Processors in New York State*. (<https://www.ams.usda.gov/services/organic-certification/certifying-agents>).
8. New York Department of Agriculture and Markets, *Organic Farming Development/ Assistance*. (<http://www.agriculture.ny.gov/AP/organic/index.html>).
9. Agriculture Marketing Service, *National Organic Program*. (<http://www.ams.usda.gov/nop/NOP/standards/ProdHandPre.html>).
10. National Sustainable Agriculture Information Service, *Organic Farming*. (<http://attra.ncat.org/organic.html>).
11. Rodale Institute. (<http://www.rodaleinstitute.org/>).
12. Federal Insecticide Fungicide Rodenticide Act (FIFRA). (2009). *Electronic Code of Federal Regulations*. Title 40: Protection of the Environment. Part 152 Pesticide registration and classification procedures. Subpart B- exemptions. Part 152.25(b). (http://www.ecfr.gov/cgi-bin/retrieveECFR?gp=&SID=93273f40edd66422070223a2ddcef5c4&mc=true&r=PART&n=pt40.24.152#se40.24.152_125).
- 12a. United States environmental Protection Agency. Minimum Risk Pesticides Exempted from FIFRA Regulation. (2015) (<http://www2.epa.gov/minimum-risk-pesticides>).
13. Office of prevention, pesticides and toxic substances. (2009). *Inert ingredients eligible for FIFRA 25(b) pesticide products*. United States Environmental Protection Agency. Washington DC. (http://www.epa.gov/opprd001/inerts/section25b_inerts.pdf).
14. Federal Insecticide Fungicide Rodenticide Act (FIFRA). (2009). *Electronic Code of Federal Regulations*. Title 7: Agriculture. National Organic Program, Part 205, sections 600-606. (<http://www.ecfr.gov/cgi-bin/text-idx?c=ecfr;sid=fbbd316a3eb4c0f243da74a9942b07d8;rgn=div7;view=text;node=7%3A3.1.1.9.32.7.354;idno=7;cc=ecfr>).
- 14a EPA Office of Prevention, Pesticides, and Toxic Substances. (2005). How To Comply with the Worker Protection Standard for Agricultural Pesticides: What Employers Need to Know. Unit 2: An Introduction to the Worker Protection Standard. 16 pp. (<https://www.epa.gov/pesticide-worker-safety/pesticide-worker-protection-standard-how-comply-manual>)

ORGANIC CUCUMBER & BUTTERNUT SQUASH PRODUCTION

- 14b National Pesticide Information Center: State Pesticide Regulatory Agencies. Cooperative agreement between Oregon State University and the U.S. Environmental Protection Agency. (<http://npic.orst.edu/mlrDetail.html?lang=en&to=SPE&state=NY#statePesticide>)
- 14c Pesticide Management Education Program (PMEP). (2013). Cornell University Cooperative Extension. (<http://psep.cce.cornell.edu/Default.aspx>).
- 14d United States Environmental Protection Agency (2016). Pesticide Worker Safety. Revisions to the Worker Protection Standard. (<https://www.epa.gov/pesticide-worker-safety/revisions-worker-protection-standard>)

Cover Crops, Soil Health, Crop Rotation

15. Cover crops for vegetable growers: online decision tool. Björkman, T. Cornell University, *Cover Crops for Vegetable Growers*. (<http://covercrops.cals.cornell.edu/decision-tool.php>).
16. Magdoff, F., VanEs, H. (2010) Sustainable Agriculture Research and Education, *Building Soils for Better Crops, 3rd Edition*. (<http://www.sare.org/publications/soils.htm>).
17. Soil Health Website, Cornell University. (<http://soilhealth.cals.cornell.edu/>).
18. Mohler, C. L. and Johnson, S. E., editors. (2009). Crop Rotation on Organic Farms: A Planning Manual. Sustainable Agriculture Research and Education. Natural Resource, Agriculture and Engineering Service. Cooperative Extension, Ithaca NY. (http://palspublishing.cals.cornell.edu/nra_crof.html).

Fertility

19. Cornell Nutrient Analysis Laboratory, (<http://cnal.cals.cornell.edu/>).
20. Agri Analysis, Inc., (<http://www.agrianalysis.com/>).
21. A&L Eastern Agricultural Laboratories, Inc, (<http://al-labs-eastern.com/>).
22. The Pennsylvania State University, *Agricultural Analytical Services Laboratory*, (<http://aasl.psu.edu>).
23. Agro-One Services, Dairy One Cooperative, Ithaca, NY. (<http://dairyone.com/analytical-services/agronomy-services/soil-testing/>).
24. University of Massachusetts, *Soil and Plant Tissue Testing Laboratory*, (<http://www.umass.edu/soiltest/>).
25. Analytical Laboratory and Maine Soil Testing Service, University of Maine. (<http://anlab.umesci.maine.edu/>).
26. Rosen, C., Bierman, P. *Using Manure and Compost as Nutrient Sources for Fruit and Vegetable Crops*. University of Minnesota. (<http://www.extension.umn.edu/distribution/horticulture/M1192.html>).
27. The Pennsylvania State University. (2015-2016). *Penn State Agronomy Guide*. Department of Agronomy. University Park, PA (<http://extension.psu.edu/agronomy-guide>)
- 27a Sánchez, E. S. and Richard, T. L., (2009) Pennsylvania State University Publication, UJ256. *Using Organic Nutrient Sources*. (<http://extension.psu.edu/publications/uj256>).
- 27b DuPont, T. (2011) Pennsylvania State University Publication, *Determining Nutrient Applications for Organic Vegetables*. (<http://extension.psu.edu/business/start-farming/soils-and-soil-management/determining-nutrient-applications-for-organic-vegetables-basic-calculations-introduction-to-soils-fact-3>).

Weed Management

28. Bowman, G., (2001) The Sustainable Agriculture Network. *Steel in the Field*. Beltsville, MD. (http://nydairyadmin.cce.cornell.edu/uploads/doc_20.pdf).
29. Cornell University, *Weed Ecology and Management Laboratory*. (<http://weedecology.css.cornell.edu/>).
30. Rutgers University, *New Jersey Weed Gallery* (<http://njaes.rutgers.edu/weeds/>).
31. University of Vermont, *Videos for Vegetable and Berry Growers*. (<http://www.uvm.edu/vtvegandberry/Videos/videos.html>).
32. Sullivan, P., National Sustainable Agriculture Information Service (formerly ATTRA), *Principles of Sustainable Weed Management for Croplands*. (<http://attra.ncat.org/attra-pub/weed.html>).
33. Colquhoun, J., Bellinder, R., Cornell University, *New Cultivation Tools for Mechanical Weed Control in Vegetables*. (<http://www.vegetables.cornell.edu/weeds/newcultivationmech.pdf>)

Managing Diseases of Cucurbits

34. Zitter, R.A., Kennelly, M.M., Vegetable MD Online. *Bacterial Wilt of Cucurbits*. (<http://vegetablemdonline.ppath.cornell.edu/factsheets/BWSigPoster.htm>)
35. North American Plant Disease Forecast Center. *Cucurbit Downy Mildew*. (<http://www.ces.ncsu.edu/depts/pp/cucurbit/>).
- 35a. McGrath, M.T., Cornell University. Vegetable Pathology- Long Island Horticultural Research and Education Center. *Downy Mildew on Cucurbits: Early Symptoms*. (<http://livegpath.cals.cornell.edu/gallery/cucurbits/downy-mildew-o-cucurbits-early-symptoms/>)

ORGANIC CUCUMBER & BUTTERNUT SQUASH PRODUCTION

36. Zitter, T.A., (1992) Cornell University, Vegetable MD Online. *Assorted foliar Diseases of Cucurbits*. Fact Sheet Page 732.90. (<http://vegetablemdonline.ppath.cornell.edu/>)
37. McGrath, M.T., Vegetable MD Online. *Identifying Initial Downy Mildew Symptoms in Cucurbits is Critical for Successful Management*. (http://vegetablemdonline.ppath.cornell.edu/NewsArticles/Cuc_Downy_Mar06.html).
38. Becker, R. and Miller, S. (2009). Ohio State University. *Managing Downy Mildew in Organic and Conventional Vine Crops*. Fact Sheet HYG-3127-09. (<http://www.maine.gov/dacf/php/gotpests/diseases/factsheets/downy-mildew-ohio.pdf>)
- 38a. North Carolina State Cucurbit Breeding; Horticultural Science website. (2014) *Cucumber Breeding at NC State*. (<http://cuke.hort.ncsu.edu/cucurbit/cuke/cukemain.html>)
39. Kuepper, G. (2003) Appropriate Technology Transfer for Rural Areas (ATTRA). *Downy Mildew Control in Cucurbits*. (<https://attra.ncat.org/attra-pub/summaries/summary.php?pub=122>).
40. New York State Agricultural Experiment Station, *Resource Guide for Organic Insect and Disease Management*. **Phytophthora Blight Symptoms on Pumpkin**. P 89. (<http://web.pppmb.cals.cornell.edu/resourceguide/pdf/resource-guide-for-organic-insect-and-disease-management.pdf>).
41. McGrath, M.T. (2001) Vegetable MD Online. **Phytophthora Blight Fact Sheet**. (http://vegetablemdonline.ppath.cornell.edu/factsheets/Cucurbit_Phytoph2.htm).
42. New York State Agricultural Experiment Station, **Powdery Mildew of Cucurbits**. (<http://nysipm.cornell.edu/factsheets/vegetables/cucu/pm.pdf>).
- 42a. McGrath, M.T. (2011) Vegetable MD Online. **Powdery Mildew of Cucurbits Fact Sheet**. (http://vegetablemdonline.ppath.cornell.edu/factsheets/Cucurbits_PM.htm)
43. Zitter, T.A. (1972) Vegetable MD Online. **Fruit Rots of Squash and Pumpkins**. (http://vegetablemdonline.ppath.cornell.edu/factsheets/Cucurbit_FrtRots.htm).
44. Plant Disease Diagnostic Clinic. Cornell University. (<http://plantclinic.cornell.edu/>).
45. Abawi, F.S., Gugino, B.K. (2007) Cornell University, New York State Agricultural Experiment Station.. *Soil Sampling for Plant-Parasitic Nematode Assessment*. (<http://www.fruit.cornell.edu/berrytool/pdfs/Soil%20Sampling%20for%20Nematode%20Assessment%20Factsheet.pdf>).
46. Cornell University, New York State Agricultural Experiment Station. *Visual Assessment of Root-Knot Nematode Soil Infestation Levels Using a Lettuce Bioassay*. (http://www.nysipm.cornell.edu/factsheets/vegetables/Soil_Bioassay_Root-Knot.pdf)
47. Gugino, B.K., Ludwig, J.W., Abawi, G.S., Cornell University, New York State Agricultural Experiment Station. *A Soil Bioassay for the Visual Assessment of Soil Infestations of Lesion Nematode*. (http://www.nysipm.cornell.edu/factsheets/vegetables/Lesion_Nematode_Bioassay.pdf).
48. University of Illinois Extension. **Alternaria Leaf Spot or Blight of Cucurbits**. (http://extension.cropsciences.illinois.edu/fruitveg/pdfs/918_alternaria_blight.pdf).
49. Grabowski, M. (2015) University of Minnesota. **Angular Leaf Spot Fact Sheet**. <http://www.extension.umn.edu/garden/yard-garden/vegetables/diseases-of-cucurbits/angular-leaf-spot/>
50. New York State Agricultural Experiment Station, *Resource Guide for Organic Insect and Disease Management*, **Older Angular Leaf Spot Lesions**. Page 88 (<http://web.pppmb.cals.cornell.edu/resourceguide/pdf/resource-guide-for-organic-insect-and-disease-management.pdf>).
- 50a. Zitter, T.A. Vegetable MD Online. **Diagnostic Key: Diseases of Cucurbit Leaves**. (<http://vegetablemdonline.ppath.cornell.edu/DiagnosticKeys/CucurLeaf/CucLeafKey.html>)
51. Vegetable MD Online. (1987) **Anthracoze Fact Sheet**. (http://vegetablemdonline.ppath.cornell.edu/factsheets/Cucurbit_Anthracoze.htm).
52. North Carolina State University, Plant Pathology Extension. *Fruit Rots of Pickling and Slicing Cucumbers*. (<http://www.ces.ncsu.edu/depts/pp/notes/Vegetable/vg1/vg1.htm#belly>)
53. Zitter, T.A. (1998) Vegetable MD Online **Fusarium Diseases of Cucurbits**. (http://vegetablemdonline.ppath.cornell.edu/factsheets/Cucurbits_Fusarium.htm).
54. Zitter, T.A. (1992) Vegetable MD Online **Gummy Stem Blight Fact Sheet**. http://vegetablemdonline.ppath.cornell.edu/factsheets/Cucurbit_GSBlight.htm).
55. Zitter, T.A. (1986) Vegetable MD Online **Scab of Cucurbits**. (http://vegetablemdonline.ppath.cornell.edu/factsheets/Cucurbit_Scab.htm).
56. Zitter, T.A. (1986) Vegetable MD Online **Sclerotinia White Mold of Cucurbits**. (http://vegetablemdonline.ppath.cornell.edu/factsheets/Cucurbit_FrtRots.htm#Click).
57. Zitter, T.A. (1992) Vegetable MD Online **Septoria Leaf and Fruit Spot of Cucurbits**. (http://vegetablemdonline.ppath.cornell.edu/factsheets/Cucurbit_Septoria.htm).
58. Vegetable MD Online. **Virus Diseases of Cucurbits**. Cornell University Department of Plant Pathology. (http://vegetablemdonline.ppath.cornell.edu/factsheets/Viruses_Cucurbits.htm).

59. Vegetable MD Online. *Photo Gallery Cucurbit Viruses Collection*.
(<http://vegetablemdonline.ppath.cornell.edu/PhotoPages/Cucurbit/CucViruses/CucVirPhotoList.htm>).

Managing Insects of Cucurbits

60. Weeden, C.R., Shelton, A.M., Hoffmann, M. P., **Biological Control: A Guide to Natural Enemies in North America**. (<http://www.biocontrol.entomology.cornell.edu/index.php>).
61. Hoffmann, M., Sanderson, J., Cornell Cooperative Extension. *Melon Aphid*. (<http://nysipm.cornell.edu/factsheets/vegetables/cucu/ma.pdf>).
62. Cucurbit IPM Scouting Procedures. Editors: T. A. Zitter, M. P. Hoffmann, M. T. McGrath, C. H. Petzoldt, A. J. Seaman, and L. H. Pedersen Cucurbit IPM Scouting Procedures (<http://www.nysipm.cornell.edu/scouting/scoutproc/cuke00.asp>)
63. Hoffmann, M.P., Zitter, T.A., Cornell Cooperative Extension. **Cucumber Beetles, Corn Rootworms, and Bacterial Wilt in Cucurbits**. (<http://www.nysipm.cornell.edu/factsheets/vegetables/cucu/cbcrbw.pdf>)
- 63a. Boucher, J., Durgy, R., Hazzard, R., and Cavanaugh, A. (2102) Connecticut Integrated Pest Management Program. Directions for Using a Perimeter Trap Crop Strategy to Protect Cucurbit Crops.
(<http://ipm.uconn.edu/documents/raw2/Directions%20For%20Using%20a%20Perimeter%20Trap%20Crop%20Strategy%20to%20Protect%20Cucurbit%20Crops/Directions%20For%20Using%20a%20Perimeter%20Trap%20Crop%20Strategy%20to%20Protect%20Cucurbit%20Crops.php?aid=87>)
- 63b. Shapiro-Ilan, D.I. Byron, G.A. and Gaugler, R. *Nematodes (Rhabditida: Steinernematidae & Heterorhabditidae) in Biological Control: A Guide to Natural Enemies in North America*. (<http://www.biocontrol.entomology.cornell.edu/pathogens/nematodes.php>)
64. VanWychen Bennett, K., Burkness, E.C., Hutchison, W.D., (2007) **Seed Corn Maggot**. University of Minnesota. (<https://www.vegedge.umn.edu/pest-profiles/pests/seed-corn-maggot>).
65. Cornell University and Northeast Organic Farmers Association. **Squash Bug slide show**. (http://nysipm.cornell.edu/vegetables/nofa/NOFA_08_sb.pdf).
66. Wilsey, W. T., Weeden, C. R. and Shelton, A. M. (2007) **Squash Bug Life Cycle**. Pests in the Northeastern United States. Cornell University, Ithaca NY. (<http://web.entomology.cornell.edu/shelton/veg-insects-ne/pests/sb.html>).
67. Cornell University and Northeast Organic Farmers Association. **Squash Vine Borer**. (http://nysipm.cornell.edu/vegetables/nofa/NOFA_08_svb.pdf).
68. Wilsey, W. T., Weeden, C. R. and Shelton, A. M. (2007) **Squash Vine Borer Cycle**. Pests in the Northeastern United States. Cornell University, Ithaca NY. (. (<http://web.entomology.cornell.edu/shelton/veg-insects-ne/pests/svb.html>)).
69. Adam, K.L. (2006) Appropriate Technical Transfer for Rural Areas (ATTTRA). **Squash Bug and Squash Vine Borer: Organic Control**. (<https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=0CB4QFjAA&url=https%3A%2F%2Fattra.ncat.org%2Fattra-pub%2Fdownload.php%3Fid%3D138&ei=jIw9Vd2NfCvvgTMhIHABQ&usq=AFOjCNEmsVKRBibTOOLivL3z8QNa5GAH4A&sig2=9oRVFW7L8EiBn7Sjou49A>).
70. Fasulo, T.R. and Denmark, H.A. (2009) University of Florida. Entomology and Nematology. Featured Creatures: **Twospotted Spider Mite**. (http://entnemdept.ufl.edu/creatures/orn/twospotted_mite.htm).

Pesticide Use, Safety, and Sprayer Calibration

71. Cornell Integrated Crop and Pest Management Guidelines (2013). *Chapter 6 Pesticide Information and Safety*. (<https://ipmguidelines.org/>).
72. *Calibration: Backpack Sprayer*. Pesticide Environmental Stewardship. Center for Integrated Pest Management. (<http://pesticidestewardship.org/calibration/Pages/BackpackSprayer.aspx>)
73. Center for Integrated Pest Management. Pesticide Environmental Stewardship: Promoting Proper Pesticide Use and Handling: Calibration. (<http://pesticidestewardship.org/calibration/Pages/default.aspx>)
74. Landers, A., Knapsack Sprayers: General Guidelines for Use. Cornell University, Ithaca, N.Y. (<http://www.google.com/url?sa=t&rct=j&q=landers%2C%20a.%2C%20knapsack%20sprayers%3A%20general%20guidelines%20for%20use.%20&source=web&cd=1&ved=0CEMQFjAA&url=http%3A%2F%2Fweb.entomology.cornell.edu%2Flanders%2Fpestapp%2Fpublicati ons%2FturF%2Fknapsack%2520sprayer1.doc&ei=UmmZT9KpE6j16AH340XEBg&usq=AFOjCNHzv77sb6R-BbWB3G0Du0dOs7rfRg&cad=rja>).
75. Miller, A. and Bellinder, R. (2001) Herbicide Application Using a Knapsack Sprayer. Department of Horticultural Science, Cornell University, Ithaca, N.Y. (<http://www.hort.cornell.edu/bellinder/spray/southasia/pdfs/knapsack.pdf>).
76. Extension: A Part of the Cooperative Extension System. (2016) Pesticide Environmental Stewardship. (<http://www.extension.org/pesticidestewardship>)
77. Center for Integrated Pest Management. Pesticide Environmental Stewardship Promoting Proper Pesticide Use and Handling. Website. (<http://pesticidestewardship.org/Pages/About.aspx>)
78. Landers, Andrew. Cornell University Department of Entomology. (2003) *Vegetable Spraying*. (<http://web.entomology.cornell.edu/landers/pestapp/vegetable.htm>)

ORGANIC CUCUMBER & BUTTERNUT SQUASH PRODUCTION

This guide is published by the New York State Integrated Pest Management Program, which is funded through Cornell University, Cornell Cooperative Extension, the New York State Department of Agriculture and Markets, the New York State Department of Environmental Conservation, and USDA-NIFA. Cornell Cooperative Extension provides equal program and employment opportunities. NYS IPM Publication number 135. June 2016
www.nysipm.cornell.edu