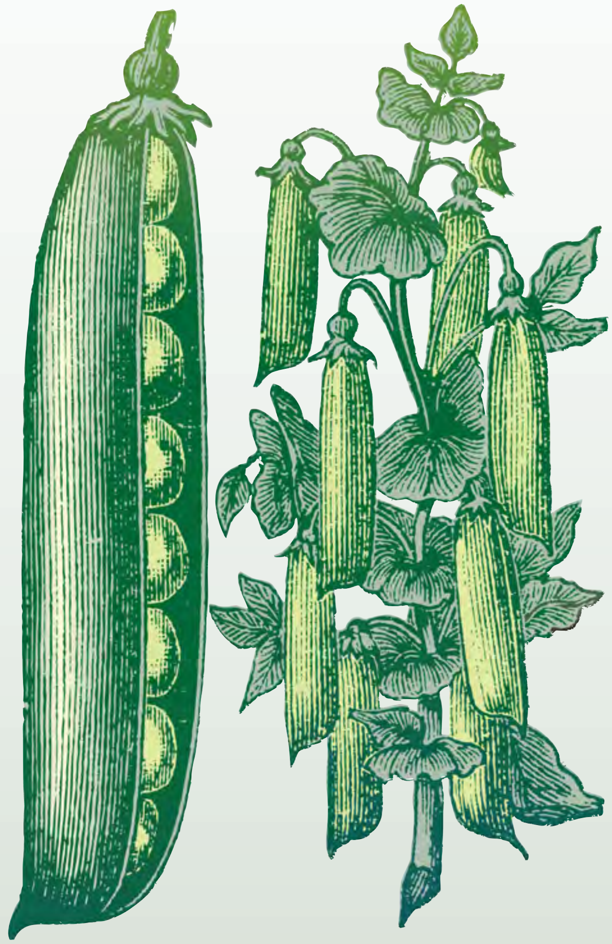
2014

Production Guide for Organic Peas for Processing



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2014 Production Guide for
Organic Peas for Processing

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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 (July 2014). 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 in 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://www.nysipm.cornell.edu/organic_guide. Please submit comments or suggested changes for these guides to organicguides@gmail.com.

2014 Organic Guides Disclaimer

Due to a funding gap, the 2014 updates to the Organic Guides were not comprehensive. We attempted to remove products that are no longer OMRI listed, and pesticide information has been reviewed for label accuracy and compliance with New York State Department of Environmental Conservation regulations. While products listed in the guides should always be checked to be sure they are NOP compliant, it is particularly important to do so this year. Products added to the OMRI list in the past year were not added to the guides and links were not updated. We hope to be able to provide comprehensive updates for 2015 and 2016.

TABLE OF CONTENTS

INTRODUCTION

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

This 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 grossing 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 4) operating in New York can be found on the New York State Department of Agriculture and Markets Organic Farming Resource Center web page (Link 5). See more certification and regulatory details under Section 4.1 and Section 10: *Using Organic Pesticides*.

1.2 Organic Farm Plan

An organic farm plan is central to the certification process. The farm plan 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 farm plan is from the NOP web site:

The Organic Food Production Act of 1990 (OFPA or Act) requires that all crop, wild crop, livestock, and handling operations requiring certification submit an organic system plan to their certifying agent and, where applicable, the State Organic Program (SOP). The organic system plan is a detailed description of how an operation will achieve, document, and sustain compliance with all applicable provisions in the OFPA and these regulations. The certifying agent must concur that the proposed organic system plan fulfills the requirements of subpart C, and any subsequent modification of the organic plan by the producer or handler must receive the approval of the certifying agent.

More details may be found at the Agricultural Marketing Service's National Organic Program website (Link 6). The National Sustainable Agriculture Information Service, (formerly ATTRA), has produced a guide to organic certification that includes templates for developing an organic farm plan (Link 7). The Rodale Institute has also developed resources for transitioning to organic and developing an organic farm plan (Link 8).

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 support 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 in the soil and 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 sod that will be in place for one or more seasons, deprives many, but not all disease-causing organisms of a host, and contributes to a healthy soil structure that promotes vigorous plant growth. The same practices are effective for preventing the buildup of a number of root damaging nematodes in the soil, especially root know nematode, but keep in mind that certain grain crops are also hosts for some nematode species including lesion nematodes. 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 by Fred Magdoff and Harold Van Es, 2010 (Link 10). For more information, refer to the Cornell Soil Health website (Link 11).

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, with their cultural requirements carefully considered including 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 Table 3.1 for more information on specific cover crops.

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, the crop can 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 a 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 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, by Marianne Sarrantonio (Reference 3), the Cornell's online decision tool to match goals, season, and cover crop (Link 9) or Cover Crops for Vegetable Production (Reference 4).

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

Legume cover crops should be avoided before peas because many are closely related to peas and share pests.

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 these plants take up nitrogen that otherwise might be leached from the soil, and release it back to the soil as they decompose. It is important to note that including grain crops either as the cash crop or cover crop in the rotation will reduce build-up of most root rot pathogens in peas. If incorporated as green manures, 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, this practice may increase slug damage and infections by fungal pathogens such as pythium and phytophthora, often affecting stand establishment.

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.

Table 3.1 Non-leguminous Cover Crops: Cultural Requirements and Crop Benefits

Species	Planting Dates	Life Cycle	Cold Hardiness Zone (Link 1)	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 [a]	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 [a]	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

Table 3.1 Non-leguminous Cover Crops: Cultural Requirements and Crop Benefits

Species	Planting Dates	Life Cycle	Cold Hardiness Zone (Link 1)	Heat	Drought	Shade	pH Preference	Soil Type Preference	Seeding (lb/A)	Comments
				--Tolerances--						
Oats	Mid-Sept-early Oct.	Summer annual [a]	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 [a]	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. AR=Annual Rye, PR=Perennial Rye.
Drought, Heat, Shade Tolerance Ratings: 1-2=low, 3-5=moderate, 6-8=high, 9-10=very high. [a] Winter killed. Reprinted with permission from Rodale Institute www.rodaleinstitute.org M. Sarrantonio. (1994) Northeast Cover Crop Handbook. (Reference 3).

4. Field Selection

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

4.1 Certification 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*). Peas generally have a low nutrient requirement (Table 4.2.1).

Crop information specific to peas

Plan at least 3 years between legume plantings. Legumes including soybean, clovers, alfalfa and hairy vetch are hosts for many soil-borne fungal pathogens and should be avoided in fields with severe root rot problems. A good rotation helps reduce the incidence of foliar diseases and lowers the population of plant pathogens that cause root rot. It is more effective to put crop rotation plans in place before pests become a major problem than to use them to try to clean up a pest problem. Corn and cereal grains are excellent rotation crops to reduce root rot problems because they are not hosts for root rot pathogens of vegetable crops or root knot nematode. They are, however, hosts for root lesion nematode.

Table 4.2.1 Crops Nutrient Requirements

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

From NRAES publication Cop Rotation on organic Farms: A Planning manual. Charles L. Mohler and Sue Ellen Johnson, editors, (Link 1)

Table 4.2.2 Potential Interactions of Crops Grown in Rotation with Peas

Crops in Rotation		**Potential Rotation Effects**	**Comments**
Field Pea Bell bean	Hardy clover Lettuce	***Sclerotinia trifoliorum*** *increase*	Both these closely related diseases (varieties of *Sclerotinia trifoliorum*) can attack a variety of crops including peas and lettuce.
Beet Crucifer greens Lettuce	Pea Radish Spinach	**Double cropping**	***Second Cropping*** : Time allows for a second crop in one season. Peas will increase soil N for the subsequent crop. Short season crops such as radish, spinach, lettuce, and crucifer greens will benefit from the increase nitrogen produced by the peas.
Brussels sprouts Cabbage Cauliflower	Corn Lettuce	*Increase* **Nitrogen**	Peas will increase nitrogen for crops that have a high need for nitrogen (see table 4.2.1).

Excerpt from Appendix 2 of Crop Rotation on Organic Farms: A Planning Manual. Charles L. Mohler and Sue Ellen Johnson, editors. (Link 12)

4.3 Pest History

It is important to know the pest history for each field to plan a successful cropping strategy. For example, 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.

If possible, peas should not be grown in fields with a history of root rot problems, but if there is no choice, plant on raised beds and when conditions favor rapid germination and root development.

Peas are a host 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 for more information on nematodes.

4.4 Soil and Air Drainage

Peas are very susceptible to root diseases and need excellent drainage and soil structure. Uniform soils are preferred because peas mature faster on well-drained soils than on heavier soils. Any practice that promotes drying or drainage of excess water from the root zone will minimize favorable conditions for infection and disease development.

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 severity for each field. Accurate identification of weeds is essential. Management plans should focus on the most challenging and potentially yield-limiting weed species in each field, being sure to emphasize options that do not exacerbate other species that are present. Alternating between early and late-planted, 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.

5.2 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. Weed fact sheets provide a good color reference for common weed identification. See Penn State weed identification (Reference 2) or Cornell weed ecology and Rutgers weed gallery websites (Links 16-17).

Begin blind cultivation with a tine weeder, or flexible harrow, before ground crack, when weeds are at white thread stage. Peas are very susceptible to breakage when they are in the "crook" stage – from just before ground crack until the seed leaves are unfolded and horizontal. Avoid tine weeding during this period. Correct cultivation depth with a tine weeder is 2/3 of seeding depth. Note, however, that penetration will vary with soil conditions and you must avoid hitting the seed with the weeder in soft spots. Effective tine weeding is an art that requires adjustment of the weeder to obtain good weed control without harming the crop. Examples of tine weeders are the Einbock, Lely, and Kovar. The tines on various brands and models of harrows differ in flexibility. Tines that are too stiff can break pea stems. Tines with a 70 to 80 degree bend work well for peas as they hook out grassy weeds without pulling out the peas, which have a taproot. Tines with a 45-degree bend can also be used effectively.

After pea emergence, make up to four more passes using the tine weeder at about 5 to 7 day intervals depending on weed growth. Tine weeders work best on very small weeds. The final tine weeding can be more aggressive (faster and deeper) than the pre-emergence weeding or early post-emergence weeding. Test settings on a small area and adjust. Stop tine weeding before vines begin to tangle.

When the crop gets too large for safe tine weeding, use a row crop cultivator to control weeds between the rows. Adjust row crop cultivator for close and shallow cultivation. Minimize turning up rocks that will cause problems with the harvester. Perennial weeds will require deeper cultivation. Using a rolling cultivator is another option but they tend to work poorly on fine textured soil unless tilth is exceptionally good.

Weeds that cause contamination problems at harvest include corn chamomile, Canada thistle, eastern black nightshade, horsenettle, and other plants in the nightshade family (Solanaceae)

Resources

Steel in the Field *by* Greg Bowman: (Link 13).
Cornell Weed Ecology website: (Link 14).
Rutgers University, New Jersey Weed Gallery (Link 15).
Univ. of Vermont videos on cultivation and cover cropping (Link 16).
ATTRA Principles of Sustainable Weed Management for Croplands: (Link 17).

New Cultivation Tools for Mechanical Weed Control in Vegetables
(Link 18)

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, Table 6.1 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.

Table 6.1 Disease Resistance and Production Qualities of Processing Peas

Processing Pea Varieties	Fusarium Wilt Resistance	Root Rot Severity Trial 1	Root Rot Severity Trial 2	Days to maturity	Vine Type	Comment
Bolero	F1 resistant	4.4	6.3	66	Normal	Height 24-36”, Good disease tolerance according to Stokes
Cosima	F1 resistant	-	-	62	Normal	Height 22”, Excellent resistance to bacterial disease according to research from Ontario Canada.
Durango	F1 resistant	-	-	66	Normal	24-36”, Powdery mildew resistant version of Bolero
ES 414	F1 resistant	-	-	44	Normal	18” high
EX 0794	F1 resistant	-	-	65	Afila	25” high
Icebreaker	F1 resistant	-	-	57	Afila	16-18” high
Ice pack	F1 resistant	-	-	58	Afila	
June	F1 resistant	5.8	6.8	59	Normal	23” high
Legacy	F1 resistant	-	-	68	Normal	Resistant to powdery mildew & pea enation
Pendleton	F1 & F2	4.0	4.9	65	Afila	23” high
Premium	F1 resistant	-	-	58	Normal	23” high
Tonic	F1 & F2	-	-	63	Normal	26” high

Root rot severity rated on a scale of 1 (no visible disease symptoms, healthy) to 9 (75% of root and stem tissues affected and at a late stage of decay) in two trials.

7. Planting

Because pea seed germinates in relatively cool soil (as low as 40°F), planting can begin in late March or early April and continue until May 20th-30th. Early plantings generally yield more than later plantings as they mature during the cooler part of summer.

Plant at a uniform depth of no more than one inch unless the soil is exceptionally dry. Rolling or cultipacking the soil after planting will firm the ground and push stones into the soil, which facilitates machine harvest. Attaching the roller behind the drill eliminates an additional set of tractor wheel marks and too much soil compaction on some rows of planted peas.

In general, seed does not need to be inoculated with symbiotic bacteria that fix nitrogen unless it has been more that 5 years since the last legume crop or unless the field has low nitrogen levels. If you do need inoculants, be careful to choose one that is listed by the Organic Materials Review Institute (Link 3).

Because seed size varies greatly between varieties, seeding rate must be adjusted accordingly. See Tables 7.1 and 7.2.

Table 7.1 Recommended Spacing for Peas.

Type	In-row (plants/yard)	Row (inches)
Early	18-22	7
Late	16-18	7

Table 7.2 Seeds per Row Based on Germination

Plants/yard	Laboratory Germination Rate (%) 100	95	90	85	80	75
	Number of seeds to drop/yard of row					
16	16	17	18	19	20	21
17	17	18	19	20	22	23
18	18	19	20	22	23	24
19	19	20	22	23	24	26
20	20	22	23	24	25	27
21	21	23	24	25	27	28
22	22	24	25	26	28	30

Approximate number of seeds to drop to obtain 16 to 22 plants per yard of row when laboratory germination is as indicated.

8. Crop and Soil Nutrient Management

To produce a healthy crop, soluble nutrients must be available from the soil in amounts that 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. 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. Restrictions in any one of the needed nutrients will slow growth and can reduce crop quality and yields.

Organic growers often speak of feeding the soil rather than feeding the plant. A more accurate statement is that organic growers focus their fertility program on feeding soil microorganisms rather than the plant. 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 and are 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, amending soils with composts or composted 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. A more sustainable, long-term approach is to rely more on legume cover crops to supply most of the nitrogen needed by the crop. 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.

The primary challenge in organic systems is synchronizing nutrient release from organic sources, particularly nitrogen, with the crop requirements. 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 - 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. Confirm the practice with your organic certifier prior to field application.

Regular soil testing helps monitor soil pH and nutrient levels, in particular phosphorus (P), potassium (K), and micronutrients. Choose a reputable soil-testing lab (Table 8.0.1) and use it consistently to avoid discrepancies caused by different soil nutrient extraction methods. Maintain a soil pH between 6.3 and 6.8 to maximize the availability of all nutrients to plants.

See Table 8.2.2 for the recommended rates of phosphorus and potassium based on soil test results. Soil tests are required prior to micronutrient application to certified organic soil. Check with your certifier that the micronutrient source is approved for use.

Table 8.0.1 Nutrient Testing Laboratories

Testing Laboratory	Soil	Compost/ Manure	Forage	Link
Cornell Soil Health Lab	x			13
Cornell Nutrient Analysis Lab	x	x		19
Agri Analysis Inc.		x		20
A & L Eastern Lab, Inc.	x	x		21
Penn State Ag. Analytical Services Lab	x	x		22
University of Massachusetts	x	x		24
Agro One Services			x	23

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.*

8.1 Fertility

Recommendations from the Cornell Integrated Crop and Pest Management Guidelines indicate a pea crop requires 50 lb. of available nitrogen (N), 100 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.

The source of these nutrients depends on soil type and historic soil management. Some soils are naturally high in P and K, or have a history of manure applications that have resulted in elevated levels. Additional plant available nutrients are supplied by decomposed soil organic matter or through specific soluble nutrient amendments applied during the growing season in organically managed systems. Many types of organic fertilizers are available to supplement the nutrients supplied by the soil. ALWAYS check with your certifier before using any product to be sure it is approved.

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 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 (Link 11). 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/A	Phosphate (P_2O_5) lbs/A	Potash (K_2O) lbs/A
1. Total crop nutrient needs			
2. Recommendations based on soil test	Not provided		
3. Credits			
a. Soil organic matter		---	---
b. Manure			
c. Compost			
d. Prior cover crop			
4. Total credits:			
5. Additional needs (2-4=)			

Line 1. Total Crop Nutrient Needs: Research indicates that an average pea crop requires 50 lbs. of available nitrogen (N), 100 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 Peas Based on Soil Tests

	Soil Phosphorus Level			Soil Potassium Level		
Level shown in soil test	low	med	high	low	med	high
	P_2O_5 lbs/A			K_2O lbs/A		
Total nutrient recommendation	100	75	50	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. For example, a soil that has 3% organic matter could be expected to provide 60 lbs N per acre.

Line 3b. Manure: Assume that applied manure will release N for three years. Based on nutrient the test of in any manure applied, estimate that roughly 50% of N is available to the crop in the first year, and 50% of the remaining N is released in each of the next two years. Remember, any raw manure applications must occur at least 120 days before harvest of a vegetable crop. Make sure to check with your certifier or marketer for separate restrictions on manure applications.

Line 3c. Compost: Estimate that between 10 and 25% of the N contained in most compost is available to the crop the first year. Compost maturity will influence how much N is 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 high total volume needed, can be very expensive for the units of N available to the crop, especially if trucking is required. Most stable composts should be considered as soil conditioners, improving soil health, microbial diversity, tilth, and nutrient retaining capacity. 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 in the current season when incorporated.

Line 4. Total Credits: In peas, N is not usually a limiting nutrient but to calculate the soil N, add together the various N values from soil organic matter, compost, and cover crops to estimate the total N 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 (40-50 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 30%, 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. **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

Nutrient Source	*Nutrient content lb/ton*			*Available nutrients lb/ton in first season*			
	N	P_2O_5	K_2O	N1	N2	P_2O_5	K_2O
Dairy (with bedding)	9	4	10	5	2	3	9
Horse (with bedding)	14	4	14	7	3	3	13
Poultry (with litter)	56	45	34	23	16	36	31
Compost (from dairy manure)	12	12	26	3	2	10	23
Composted poultry manure (no litter)	80	104	48	40	40	104	48
Swine (no bedding)	6	7	7	2	2	5	6
	Nutrient content lb/1000 gal.			*Available nutrients lb/1000 gal first season*			
Swine finishing (liquid)	50	55	25	25 [a]	30+	44	23
Dairy (liquid)	28	13	25	14 [a]	17+	10	23

N1= incorporated within 12 hours of application, N2 =incorporated after 1 week or more, [a] injected, + incorporated.
(Adapted by Vern Grubinger from *"Using Manure and Compost as Nutrient Sources for Fruit and Vegetable Crops"* by Carl Rosen and Peter Bierman (Link 26).

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

Table 8.2.4 Available Nitrogen in Organic Fertilizer

	Pounds of Fertilizer/Acre to Provide X Pounds of N per Acre				
Sources	**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_2O	500	1000	1500	2000	2500
Fish meal 9% N, also contains 6% P_2O_5	220	440	670	890	1100
Alfalfa meal 2.5% N also contains 2% P and 2% K_2O	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.

Table 8.2.5 Available Phosphorous in Organic Fertilizers.

	Pounds of Fertilizer/Acre to Provide X Pounds of P_2O_5 Per Acre				
Sources	**20**	**40**	**60**	**80**	**100**
Bonemeal 15% P_2O_5	130	270	400	530	670
Rock Phosphate 30% total P_2O_5 (x4) [a]	270	530	800	1100	1300
Fish meal, 6% P_2O_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.

Table 8.2.6 Available Potassium in Organic Fertilizers.

	Pounds of Fertilizer/Acre to Provide X Pounds of K_2O per acre:				
Sources	**20**	**40**	**60**	**80**	**100**
Sul-Po-Mag 22% K_2O also contains 11% Mg	90	180	270	360	450
Wood ash (dry, fine, grey) 5% K_2O, also raises pH	400	800	1200	1600	2000
Alfalfa meal 2% K_2O also contains 2.5% N	1000	2000	3000	4000	5000
Greensand or Granite dust 1% K_2O (x 4) [a]	8000	16000	24000	32000	40000
Potassium sulfate 50% K_2O	40	80	120	160	200

[a] Application rates for some materials are multiplied to adjust for their slow to very slow release rates. Tables 8.3 to 8.5 adapted by Vern Grubinger from the University of Maine soil testing lab (Link 25).

An example:
How to determine nutrient needs in peas.
You will be growing an acre of peas. The macronutrient requirement for a pea crop is 40-50 lb N, 100lbs P and 120 lbs K per acre. Your soil test results show high P and K levels with 50 lb P_2O_5 and 40 lb K_2O/acre recommended (see Table 8.2.7). The field you'll be planting has 3% organic matter and a pH of 6.5, and you're planting into a winter-killed oat residue that was seeded in early September after you incorporated 2000 gallons of liquid dairy manure.

Table 8.2.7 Pea example: calculating nutrient credits and needs based on soil sample recommendations.

	Nitrogen (N) lbs/acre	Phosphate (P_2O_5) lbs/acre	Potash (K_2O) lbs/acre
1. Total crop nutrient needs:	40-50	100	120
2. Recommendations based on soil test	# not provided	50	40
3. Credits			
a. Soil organic matter 3%	60	-	-
b. Liquid Manure – 2000 gal dairy	34	20	46
c. Compost - none	0	0	0
d. Cover crop – oat residue	0	0	0
4. Total credits:	**94**	**20**	**46**
5. Additional needed (2-4) =	0	30	0

Both N and K are in adequate supply in this example. To increase available P by 30 lbs, add approximately 400 lbs of rock phosphate, banded at planting, 2-3 inches to the side and below the furrow.

9. Harvesting

Intact pea pods serve as controlled atmospheric storages that maintain quality for about one week at 32°F and 90-95% relative humidity. Once shelled, quality deteriorates rapidly. For this reason, processing peas, which are shelled in the field, must be transported quickly (usually within a few hours) to the processing facility.

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). The active ingredients of some biological pesticides (e.g. Serenade and Sonata) 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

Cornell Integrated Crop and Pest Management Guidelines: Pesticide Information and Safety (Link 39).
Calibrating Backpack Sprayers (Link 40).
Agricultural Pocket Pesticide Calibration Guide (Link 41).
Knapsack Sprayers – General Guidelines for Use (Link 42)
Herbicide Application Using a Knapsack Sprayer (Link 43) this publication is relevant for non-herbicide applications).

10.2 Regulatory Considerations

Organic production focuses on cultural, biological, and mechanical techniques to manage pests on the farm, but in some cases organically approved pesticides, which include repellents, are a necessary option. Pesticides mentioned in this organic production guide must be registered and labeled at the federal level for use, like any other pesticide, by the Environmental Protection Agency (EPA), or meet the EPA requirements for a "minimum risk" pesticide, making it exempt from normal registration requirements as described in FIFRA regulation 40 CFR Part 152.25(b).

"Minimum risk" pesticides, also referred to as 25(b) pesticides, must meet specific criteria to achieve the "minimum risk" designation. The active ingredients of a minimum-risk pesticide must be on the list of exempted active ingredients found in the federal regulations (40 CFR 152.25). Minimum-risk pesticides must also contain inert ingredients listed on the most current List 4A published in the Federal Register.

In addition to meeting the active and inert ingredient requirements above, a minimum-risk pesticide must also meet the following:

- Each product must bear a label identifying the name and percentage (by weight) of each active ingredient and the name of each inert ingredient.
- The product must not bear claims to either control or mitigate microorganisms that pose a threat to human health, including, but not limited to, disease-transmitting bacteria or viruses, or claim to control insects or rodents carrying specific diseases, including, but not limited to, ticks that carry Lyme disease.
- The product must not include any false or misleading labeling statements.

Besides registration with the EPA, pesticides sold and/or used in New York State must also be registered with the New York State Department of Environmental Conservation (NYS DEC). However, pesticides meeting the EPA "minimum risk" criteria described above do not require registration with the NYS DEC.

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. The Organic Materials Review Institute (OMRI) (Link 3) is one organization that reviews and publishes products they find compliant with the NOP regulations, 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 potential pesticides.

Finally, each farm must be certified by an accredited certifier who must approve any material applied for pest management. ALWAYS check with the certifier before applying any pest control products.

Some organic certifiers may allow "home remedies" to be used to manage pests. These materials are not labeled as pesticides, but may have properties that reduce the impact of pests on production. 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. Home remedies are not mentioned in these guides, but in some cases, may be allowed by organic certifying agencies. Maintaining good communication with your certifying agent cannot be overemphasized in order to operate within the organic rules.

10.3 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 35) 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. 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 under *Crop Management Tools and Production Aids* (Link 3). 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. Thoroughly cover plant surfaces, especially in the case of insecticides, since many must be ingested to be effective. 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.

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). Plant only clean, vigorous, and pathogen-free seed and maintain the best growing conditions possible. Viruses such as Pea Enation, Pea Streak and Pea Stunt are no longer a concern as long as seed stock is grown in dry western climates where these viruses are rare.

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. Rotation with a grain crop, preferably a sod that will be in place for one or more seasons, deprives many 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.

Other important cultural practices can be found in the following sections under each individual disease. 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 drying of leaf and soil surfaces, 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 or dew, should be avoided if possible.

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. 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.

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, the Cornell Cooperative

Extension Regional Vegetable Program in Western New York offers subscriptions to *Pestminder*, a report that gives timely information regarding crop development, pest activity and control, and *VegEdge*, a monthly newsletter with articles on pest management. On Long Island, see the *Long Island Fruit and Vegetable Update*.

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**.

Resources:

Cornell Vegetable MD online: (Link 27).

Resource Guide for Organic Insect and Disease Management (Link 35).

Table 11.0 Pesticides Labeled for Disease Control in Organic Peas

At the time this guide was produced, the following materials were labeled 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. Those pesticides meeting requirements in EPA Ruling 40 CFR Part 152.25(b) (also known as 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.**

CLASS OF COMPOUND Product name *(Active ingredient)*	Seed Decay/Root Rot	Fusarium Wilt	Leaf Spot
BIOLOGICAL			
Actino-Iron (*Streptomyces lydicus)*	X	X	
Actinovate AG *(Streptomyces lydicus)*	X	X	
BIO-TAM (*Trichoderma asperellum, Trichoderma gamsii*)	X	X	
Double Nickel 55 Biofungicide (*Bacillus amyloliquefaciens str. D747*)	X	X	
Double Nickel LC5 Biofungicide (*Bacillus amyloliquefaciens str. D747*)	X	X	
MycoStop *(Streptomyces griseoviridis)*	X	X	
MycoStop Mix (*Streptomyces griseoviridis)*	X	X	
Prestop *(Gliocladium catenulatum str. J1446)*	X	X	
Regalia Biofungicide *(Reynoutria sachalinensis)*	X	X	
RootShield PLUS+ Granules *(Trichoderma harzianum str. T-22, Trichoderma virens str. G-41)*	X	X	
RootShield PLUS+ WP *(Trichoderma harzianum str. T-22, Trichoderma virens str. G-41)*	X	X	
Serenade Soil (*Bacillus subtilis*)	X	X	
SoilGard *(Gliocladium virens str. GL-21)*	X		
Taegro Biofungicide (*Bacillus subtilis*)	X	X	
BOTANICAL			
Sporatec *(rosemary, clove, thyme oil)*	X		
Trilogy *(neem oil)*			X
COPPER			
Basic Copper 53 *(basic copper sulfate)*			X
Camelot O (*copper octanoate*)			X
Cueva Fungicide Concentrate (*copper octanoate*)			X
OTHER			
EcoMate ARMICARB 0 (*potassium bicarbonate)*			X
Microthiol Disperss (*sulfur*)			X
Oxidate Broad Spectrum (*hydrogen dioxide*)	X	X	
OxiDate 2.0 *(hydrogen dioxide, peroxyacetic acid)*	X	X	
PERpose Plus (*hydrogen peroxide/dioxide*)	X	X	X

X-labeled for use in NYS and also listed on the Organic Materials Review Institute

11.1 Seed Decay and Root Rot Diseases

Pythium ultimum, Rhizoctonia solani, Fusarium solani, and/or *Thielaviopsis basicola.*

Time for concern: At planting and early growth stages

Key characteristics: Seed decay and damping off diseases result in poor emergence and stand establishment and are caused primarily by Pythium and Rhizoctonia. Later infections caused by one or any combination of the listed pathogens result in various root-rot symptoms, depending on the pathogen(s) involved. Severely infected plants are stunted, yellow, yield poorly and may die prematurely.

Management Option	Recommendations for Seed Decay and Root Rot Diseases
Scouting/thresholds	Choose healthy and well-drained soils. A soil-indexing procedure that differentiates relatively pathogen-free fields from those with severe root rot problems is available. See the Cornell Soil Health Manual (Link 11) for directions to do this yourself, or send a sample to Cornell for testing. No threshold levels are available.
Resistant varieties	No resistant varieties are available, but a number of varieties are tolerant and perform well under high root rot pressure.
Crop rotation	Root rot is favored by short rotations. Peas should be planted only once every four years, and fields with a history of severe root rot should be avoided. Rotations with grain crops will improve soil structure and reduce disease severity.
Site selection	Select vigorous, disease-free seed.
Seed selection/treatment	These are not currently viable management options.
Postharvest & Sanitation	If possible, plow under crop debris and plant a cover crop.

At the time this guide was produced, the following materials are labeled 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. (Those pesticides meeting 25(b) requirements do not require registration.) Current NY pesticide registrations can be checked on the Pesticide Product, Ingredient, and Manufacturer System (PIMS) website http://pims.psur.cornell.edu (Link 2). ALWAYS CHECK WITH YOUR CERTIFIER before using a new product.

Table 11.1 Pesticides Labeled for Management of Seed Decay and Root Rot Diseases

CLASS OF COMPOUND Trade Name (active ingredient)	Product Rate	PHI (days)	REI (hours)	Efficacy	Comments
BIOLOGICAL					
Bacillus spp.					
Double Nickel 55 Biofungicide (*Bacillus amyloliquefaciens str. D747*)	0.125-1 lb/ treated acre as drench, band or in-furrow	0	4	?	
Double Nickel LC Biofungicide (*Bacillus amyloliquefaciens str. D747*)	0.5-4.5 pints/ treated acre as drench, band or in-furrow	0	4	?	
Serenade Soil (*Bacillus subtilis*)	2-6 qts/A	0	4	?	Soil surface drench. Not labeled for *Thielaviopsis*

Table 11.1 Pesticides Labeled for Management of Seed Decay and Root Rot Diseases					
CLASS OF COMPOUND **Trade Name** **(active ingredient)**	**Product Rate**	**PHI (days)**	**REI (hours)**	**Efficacy**	**Comments**
Taegro Biofungicide (*Bacillus subtilis*)	2.6 oz/100 gal water (drench) 3 tsp/gal (seed treatment) 2.6oz /100 gal water for 2 acres (in-furrow)	-	24	?	Not labeled for *Thielaviopsis* For seed treatment, allow seeds to soak for 10-30 minutes For row crops, apply over furrow at time of planting. Water-in with at least 0.1 inch of water.
Gliocladium					
Prestop *(Gliocladium catenulatum str. J1446)*	0.1-1% suspension	-	0	?	Soil drench application. Treat only the growth substrate when above-ground harvestable food commodities are present.
SoilGard *(Gliocladium virens str. GL-21)*	2-10 lbs/A	-	0	?	
Reynoutria					
Regalia Biofungicide *(Reynoutria sachalinensis)*	1-4 qts/A	0	4	?	Not labeled for *Thielaviopsis* control. Applied as an in-furrow treatment.
Streptomyces spp.					
Actino-Iron (*Streptomyces lydicus* WYEC 108)	10-15 lb/A (in furrow application)	-	4	3	*Streptomyces lydicus* products effective in 0/6 trials. Water in after application.
Actinovate AG (*Streptomyces lydicus WYEC 108*)	3-12 oz/A as soil treatment	0	1 hour or until dry	3	*Streptomyces lydicus* products effective in 0/6 trials. Apply in 10-200 gallons of water per acre. Not labeled for Thielaviopsis.
Mycostop (*Streptomyces griseoviridis Strain K61*)	0.07 oz/lb. seed (as seed treatment 0.07 oz/100-200 sq ft (as soil spray or drench	-	4	?	Irrigate within 6 hours after soil spray or drench with enough water to move Mycostop into the root zone.
Mycostop Mix (*Streptomyces griseoviridis*)	5-8oz/100 lbs seed as a seed treatment 7	-	4	?	Apply to seeds as planter box treatment.
Trichoderma spp.					
BIO-TAM (*Trichoderma asperellum, Trichoderma gamsii*)	1.5-3 oz/1000 row ft, in-furrow 2.5-3.0 lbs/ treated acre as band	-	1	?	
RootShield PLUS+ Granules *(Trichoderma harzianum str. T-22, Trichoderma virens str. G-41)*	2.5-6 lb/half acre	-	0	3	Trichoderma harzianum products effective in 0/2 trials. In-furrow application.

Table 11.1 Pesticides Labeled for Management of Seed Decay and Root Rot Diseases					
CLASS OF COMPOUND **Trade Name** **(active ingredient)**	**Product Rate**	**PHI (days)**	**REI (hours)**	**Efficacy**	**Comments**
RootShield PLUS+ WP *(Trichoderma harzianum str. T-22, Trichoderma virens str. G-41)*	Field chemigation: 3-8 oz/100 gal water	0	4	3	Trichoderma harzianum products effective in 0/2 trials. Do not apply when above-ground harvestable food commodities are present. Do not apply with overhead irrigation.
OTHER					
OxiDate Broad Spectrum (*hydrogen dioxide*)	0.5-1 gal/ treated acre (in-furrow) 0.33-1 gal/100 gal (surface application)	0	until dry	?	Not labeled for *Thielaviopsis* control. Make in-furrow application just prior to seed drop. Use higher rate in fields with disease history For surface application, apply as foliar spray using 30-100 gallons mix per treated acre to achieve run-off to soil. Reapply every seven days through infectious season.
OxiDate 2.0 *(hydrogen dioxide, peroxyacetic acid)*	At planting: ½-1 gal/A in 50-200 gal water Surface application: 1/3 – 1 gal/100 gals water	0	until dry	?	Typical applications use 30-100 gals of spray solution per acre.
PERpose Plus (*hydrogen peroxide/dioxide*)	1 fl oz/gal (initial/curative) 0.25-0.33 fl oz/gal (weekly preventative) 1 fl oz/ gal	-	1 (interior) until dry (field)	?	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. As a soil drench at time of seeding.
Sporatec *(rosemary, clove, thyme oil)*	1-3 pts/A	0	0	?	25(b) pesticide.

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

11.2 Fusarium Wilt, *Fusarium oxysporum f. sp. pisi*

Time for concern: Planting to harvest, when the soil temperature exceeds 68°F

Key characteristics: Fusarium wilt causes the downward curling of leaves and stipules. Leaves and stems become brittle. Yellow to orange discoloration also occurs within the vascular tissue of roots and stems (Reference 1). See University of Illinois fact sheet (Link 28).

Management Option	Recommendations for Fusarium Wilt
Scouting/thresholds	Soil can be indexed for diagnosing severely infested fields.

Resistant varieties	See table 6.1
Crop rotation	This fungus may remain in the soil for ten years, making rotation relatively ineffective. However, practicing rotation in relatively clean fields will help prevent disease/pathogen build-up.
Site selection	Plant in the earliest workable fields, so the crop develops during the period of the growing season when the soil temperature is below the optimum temperature for wilt development (68°F through 72°F).
Seed selection/treatment, Postharvest, and Sanitation	These are not currently viable management options.
Compound(s)	See Table 11.2 for allowable pesticides. .

At the time this guide was produced, the following materials are labeled 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. (Those pesticides meeting 25(b) requirements do not require registration.) Current NY pesticide registrations can be checked on the Pesticide Product, Ingredient, and Manufacturer System (PIMS) website http://pims.psur.cornell.edu (Link 2). ALWAYS CHECK WITH YOUR CERTIFIER before using a new product.

Table 11.2 Pesticides Labeled for Management Fusarium Wilt

CLASS OF COMPOUND Trade Name (*active ingredient*)	**Product Rate**	**PHI (days)**	**REI (hours)**	**Efficacy**	**Comments**
BIOLOGICAL					
Bacillus					
Double Nickel 55 Biofungicide (*Bacillus amyloliquefaciens str. D747*)	0.125-1 lb/ treated acre as drench, band or in-furrow	0	4	?	
Double Nickel LC Biofungicide (*Bacillus amyloliquefaciens str. D747*)	0.5-4.5 pints/ treated acre as drench, band or in-furrow	0	4	?	
Serenade Soil (*Bacillus subtilis*)	2-6 qts/A	0	4	1	Effective in 1 trial. Soil surface drench
Taegro Biofungicide (*Bacillus subtilis*)	3.5 fl oz/100 water (drench) 3 tsp/gal water (seed treatment) 2.6 oz/100 gal water for 2 acres (row crop)	-	24	?	For seed treatment, allow seeds to soak for 10-30 minutes For row crops apply over furrow at time of planting. Water-in with at least 0.1 inch of water.
Gliocladium					
Prestop (*Gliocladium catenulatum str. J1446*)	0.1-1% suspension	-	0	?	Treat only the growth substrate when above-ground harvestable food commodities are present.
Reynoutria					
Regalia Biofungicide (*Reynoutria sachalinensis*)	1-4 qts/A	0	4	?	Applied as in-furrow treatment.
Streptomyces					

Table 11.2 Pesticides Labeled for Management Fusarium Wilt					
CLASS OF COMPOUND **Trade Name** **(*active ingredient*)**	**Product Rate**	**PHI (days)**	**REI (hours)**	**Efficacy**	**Comments**
Actino-*Iron* *(Streptomyces lydicus WYEC 108)*	10-15 lb/A	-	4	?	Water in after application
Actinovate AG (*Streptomyces lydicus* WYEC *108)*	3-12 oz/A as soil treatment	0	1 hour or until dry	?	
Mycostop Mix (*Streptomyces griseoviridis*)	5 - 8oz/100 lbs seed as a seed treatment 7.6-30 oz/A as soil spray or drench 0.5-1 lb/ treated acre as band, in-furrow or side dress.	-	4	?	Apply to seeds as planter box treatment. Use at planting; no pre-harvest interval noted. Irrigate within 6 hours after soil spray or drench with enough water to move Mycostop into the root zone. Lightly incorporate furrow or band applications.
Mycostop *(Streptomyces griseoviridis* Strain K61)	0.07 oz/lb seed (as seed treatment) 0.07 oz/ 100-200 sq ft (as soil spray or drench)	-	4	?	Irrigate within 6 hours after soil spray or drench with enough water to move Mycostop into the root zone.
Trichoderma					
BIO-TAM (*Trichoderma asperellum, Trichoderma gamsii*)	1.5-3 oz/1000 row ft,in-furrow 2.5-3.0 lbs/ treated acre as band	-	1	?	
RootShield PLUS+ Granules *(Trichoderma harzianum str. T-22, Trichoderma virens str. G-41)*	2.5-6 lb/half acre	-	0	?	In-furrow application.
RootShield PLUS+ WP *(Trichoderma harzianum str. T-22, Trichoderma virens str. G-41*	Field Chemigation: 3-8 oz/100 gal water	0	4	?	Do not apply with overhead irrigation. Do not apply when above-ground harvestable food commodities are present.
OTHER					
OxiDate Broad Spectrum (*hydrogen dioxide*)	0.5-1 gal/ treated acre (in-furrow) 0.33-1 gal/100 gal (surface application)	0	until dry	?	Make in-furrow application just prior to seed drop. Use higher rate in fields with disease history For surface application, apply as foliar spray using 30-100 gallons mix per treated acre to achieve run-off to soil. Reapply every seven days through infectious season.
OxiDate 2.0 *(hydrogen dioxide, peroxyacetic acid)*	At planting: ½-1 gal/A in 50-200 gals water Surface application: 1/3 – 1 gal/100 gals water	0	until dry	?	

Table 11.2 Pesticides Labeled for Management Fusarium Wilt					
CLASS OF COMPOUND Trade Name (*active ingredient*)	Product Rate	PHI (days)	REI (hours)	Efficacy	Comments
PERpose Plus (*hydrogen peroxide/dioxide*)	1 fl oz/gal (initial/curative) 0.25-0.33 fl oz/gal (weekly preventative) 1 fl oz/ gal	-	1 (interior) until dry (field)	?	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. As a soil drench at time of seeding.

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

11.3 Ascochyta Leaf Spot, *Ascochyta pisi*

Time for concern: Seedling through harvest

Key characteristics: *Ascochyta* spp. causes leaf lesions with concentric ring pattern. Other species of Ascochyta affect seeds and developing seedlings (Reference 1).

Management Option	Recommendations for Ascochyta Leaf Spot
Scouting/thresholds	Record the occurrence and severity of Ascochyta leaf spot. No thresholds have been established.
Resistant varieties	No resistant varieties are available.
Crop rotation	Two- to three-year rotation will be effective in reducing disease severity.
Seed selection/treatment	In the absence of seed treatments, pea seed should be held for one year to reduce pathogen level to one-third its previous level. Planting seeds that were produced in dryer climates to help reduce infection.
Postharvest	If possible disk and plow under crop debris immediately after harvest to reduce this source of inoculum.
Site selection, Sanitation	Field preparation to facilitate good drainage will help reduce disease.

At the time this guide was produced, the following materials are labeled 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. (Those pesticides meeting 25(b) requirements do not require registration.) Current NY pesticide registrations can be checked on the Pesticide Product, Ingredient, and Manufacturer System (PIMS) website http://pims.psur.cornell.edu (Link 2). ALWAYS CHECK WITH YOUR CERTIFIER before using a new product.

Table 11.3 Pesticides Labeled for Management of Ascochyta Leaf Spot					
CLASS OF COMPOUND Product *(Active ingredient)*	Rate	PHI (days)	REI (hours)	Efficacy	Comments
COPPER					
Basic Copper 53 (*basic copper sulfate*)	1 ¾-3 lbs/100 gal water	Up to day of harvest	24	?	Apply 100-150 gal/acre with dilute ground sprayer; apply 20-50 gal acre with concentrate sprayer

Table 11.3 Pesticides Labeled for Management of Ascochyta Leaf Spot					
CLASS OF COMPOUND Product *(Active ingredient)*	**Rate**	**PHI (days)**	**REI (hours)**	**Efficacy**	**Comments**
Camelot O *(copper octanoate)*	0.5-2 gal/100 gal water	Up to day of harvest	4	?	Apply 50-100 gallons of diluted spray per acre.
Cueva Fungicide Concentrate (*copper octanoate*)	0.5-2.0 gal/100gal water	Up to day of harvest	4	?	Apply 50-100 gallons of diluted spray per acre.
OIL					
Sporatec (*rosemary, clove, and thyme oils*)	1-3 pts/A	0	0	?	25(b) pesticide. Conduct phytotoxicity test before applying.
Trilogy *(hydrophobic extract of neem oil)*	0.5-1% in 25-100 gal of water/A	Up to day of harvest	4	?	Limited to a maximum of 2 gal of Trilogy/acre/application.
SULFUR					
Microthiol Disperss (*sulfur*)	3-10 lbs/A	-	24	?	Do not apply within 2 weeks of an oil application. Manufacturer does not recommend applying this product when temperature will exceed 90°F within three days following application. (Crop injury may result.)
OTHER					
EcoMate ARMICARB 0 (*potassium bicarbonate*)	2.5-5.0 lbs/100 gal water	0	4	?	Apply a minimum of 20 gal dilute spray per acre
PERpose Plus (*hydrogen peroxide/dioxide*)	1 fl oz/gal (initial/curative) 0.25-0.33 fl oz/gal (weekly preventative)	-	1 (interior) until dry (field)	?	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.

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

12. NEMATODES

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

Time for concern: Nematodes are seldom an important pest control issue in peas. Fields with low infestations of nematodes generally have no significant effects on yield. Peas are a good host for nematodes, but because they are planted early and grow during cool weather, they are harvested before damage from nematodes becomes evident. Long term planning is required for sustainable management in heavily infested fields keeping in mind that subsequent crops may be more susceptible to large populations.

Key characteristics: Key characteristics: In the field, plants severely infected with either nematode generally lack vigor, are stunted and can be chlorotic. Below ground, 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 lesion nematode does not cause any specific symptoms on the roots.

Management Option	Recommendation for Nematodes
Scouting/thresholds	Use a soil bioassay with lettuce and soybean to assess soil root-knot and root-lesion nematode infestation levels, respectively. Or, submit the soil sample(s) for nematode

Management Option	Recommendation for Nematodes
	analysis at a public or private nematology lab (Link 29). See Section 4: Field Selection for more information, as well as the following Cornell publications for instructions: "How to" instructions for soil sampling for nematode bioassays (Link 30). "How to" instructions for farmers to conduct a field test for root knot nematode using lettuce (Link 31). "How to" instructions for farmers to conduct a field test for root lesion nematode using soybean (Link 32).
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 lesion and root-knot nematodes are present in the same field then rotation with a grain crop may increase the lesion nematode population to a damaging level for the next crop. In addition to grain crops, lesion nematode has over 400 hosts including many vegetables that are planted in rotation with peas thus making it difficult to manage 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.
Cover crops	Winter 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 both nematodes. Research has suggested that sudangrass hybrid 'Trudan 8' can be used effectively as a biofumigant to reduce 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 lesion nematode populations when used as a "standard" cover crop. See Field Selection section 4 above.
Sanitation	Avoid moving soil from infested fields to un-infested 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 lesion nematode; therefore effective weed management is also important.

Table 12.1 Pesticides Labeled for Management of Nematodes					
CLASS OF COMPOUND Product *(Active ingredient)*	Rate	PHI (days)	REI (hours)	Efficacy	Comments
BOTANICAL					
Molt-X (*azadirachtin*)	10 oz/A	0	4	?	Spray when pests first appear.

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

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 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 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 (Link 33) and A Guide to Natural Enemies in North America (Link 34).

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 (Link 33).
Biological Control: A Guide to Natural Enemies in North America (Link 34).
Resource Guide for Organic Insect and Disease Management (Link 35).

13.1 Seedcorn Maggot, *Delia platura*

Time for concern: At planting

Key characteristics: Adult flies are slender, 1/4 inch long, and grayish black in color. Maggots are yellowish white. See University of Minnesota fact sheet and Cornell fact sheet (Links 36, 37). Infested seeds and other plant parts are hollowed out. Damaged plants are weak and may not develop.

Management Option	Recommendations for Seedcorn Maggot
Scouting/thresholds	Record the occurrence and severity of seedcorn maggot damage. No thresholds have been established.
Natural enemies	Predators, parasitoids, and pathogens, including nematodes, may help suppress infestations. Use Link 33 or see Cornell Guide to Natural Enemies (Link 34).
Resistant varieties	No resistant varieties are available.
Site selection	Crop residue and fresh manure attract adult flies that feed on the organic matter and lay eggs. Root maggots hatch and feed on the organic matter. Therefore, incorporating crop residues well before planting is important. Do not spread manure directly before planting.
Seed selection/treatment	These are not currently viable management options.
Crop rotation, Post-harvest, and Sanitation	These are not currently viable management options.

At the time this guide was produced, the following materials were labeled 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. Those pesticides meeting requirements in EPA Ruling 40 CFR Part 152.25(b) (also known as 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.

13.1 Pesticides Labeled for Management of Seedcorn maggot

CLASS OF COMPOUND Product *(Active ingredient)*	Rate	PHI (days)	REI (hours)	Efficacy	Comments
BOTANICAL					
Aza-Direct *(azadirachtin)*	1-2 pints/A	0	4	?	
AzaGuard *(azadirachtin)*	10 -16 fl oz/A	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 ft2	0	4	?	
Ecozin Plus 1.2% ME *(azadirachtin)*	15-30 oz/A	0	4	?	Time sprays to anticipate egg hatch or when pests first appear. Drench soil to kill larvae. Make at least 2 applications in sequence 7-10 days apart for maximum efficacy
Molt-X *(azadirachtin)*	10 oz/A	0	4	?	Spray when pests first appear.
PyGanic EC 1.4 II *(pyrethrins)*	16-63 fl oz/A	0	12	?	Labeled "for the kill of insects".
PyGanic EC 5.0 II *(pyrethrins)*	4.5-17 fl oz/A	0	12	?	Labeled for maggots.

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

14. SLUGS

Time of concern: Early spring and fall

Key characteristics: Adult slugs are between one and two inches in length. Slugs can overwinter at any stage of development. Although slugs cannot survive prolonged subzero temperatures or desiccation, the burrows of small mammals and worms provide insulation. Slugs begin to move, hatch, feed, and lay eggs in the spring when temperatures are consistently above 40°F. There is often little or no slug activity in the field during periods of dry weather; however, there may be extensive feeding in damp areas. See Ohio State University fact sheet (Link 38).

Management Option	Recommendations for Slugs
Scouting/thresholds	Record the occurrence and severity of slug damage. No thresholds have been established.
Resistant varieties	No resistant varieties are available.
Site selection/planting, Crop rotation, Post-harvest, and Sanitation	Practices that help dry the soil surface for example conventional tillage, good weed control, and using raised beds that dry out more readily than flat beds, will reduce slug populations. Heavy organic mulch creates an ideal environment for slugs.

At the time this guide was produced, the following materials are labeled 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. (Those pesticides meeting 25(b) requirements do not require registration.) Current NY pesticide registrations can be checked on the Pesticide Product, Ingredient, and Manufacturer System (PIMS) website http://pims.psur.cornell.edu (Link 2). ALWAYS CHECK WITH YOUR CERTIFIER before using a new product.

Table 13.1 Pesticides Labeled for Management of Slugs

CLASS OF COMPOUND Product Name (active ingredient)	Product Rate	PHI (days)	REI (hours)	Efficacy	Comments
IRON PHOSPHATE					
Sluggo AG (*iron phosphate*)	20-44 lbs/A (0.5-1 lb/1000 ft^2)	0	0	1	Effective in 1 trial.
Sluggo Slug and Snail Bait (*iron phosphate*)	20-44 lbs/A (0.5-1 lb/1000 ft^2)	0	0	?	
IRON PHOSPHATE AND SPINOSAD					
Bug-N-Sluggo *(iron phosphate and spinosad)*	20-44 lbs/A	3	4	?	
OTHER					
BioLink (*garlic juice)*	0.5-2 qts/A	-	-	?	25(b) pesticide.
Garlic Barrier (*garlic juice)*)	1gal/99 gal water mix, spray at 10 gal mix/A	-	4	?	25(b) pesticide.

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

15. PESTICIDES AND ABBREVIATIONS MENTIONED IN THIS PUBLICATION

Table 1. Insecticides and Molluscicides mentioned in this publication

TRADE NAME	COMMON NAME	EPA REG. NO.
AZA-Direct	*azadirachtin*	71908-1-10163
AzaGuard	*azadirachtin*	70299-17

Table 1. Insecticides and Molluscicides mentioned in this publication

TRADE NAME	COMMON NAME	EPA REG. NO.
AzaMax	*azadirachtin*	71908-1-81268
Azatrol EC	*azadirachtin*	2217-836
BioLink	*garlic juice*	Exempt - 25(b) pesticide
Bug-N-Sluggo	*iron phosphate and spinosad*	67702-24-70051
Ecozin Plus 1.2% ME	*azadirachtin*	5481-559
Garlic Barrier	*garlic juice*	Exempt - 25(b) pesticide
Molt-X	*azadirachtin*	68539-11
PyGanic EC 1.4 II	*pyrethrins*	1021-1771
PyGanic EC 5.0 II	*pyrethrins*	1021-1772
Sluggo AG	*iron phosphate*	67702-3-54705
Sluggo Slug and Snail Bait	*iron phosphate*	67702-3-70051

Table 2. Fungicides mentioned in this publication

TRADE NAME	COMMON NAME	EPA REG. NO.
Actino-Iron	*Streptomyces lydicus WYEC 108*	73314-2
Actinovate AG	*Streptomyces lydicus WYEC 108*	73314-1
Basic Copper 53	*basic copper sulfate*	45002-8
BIO-TAM	*Trichoderma asperellum, Trichoderma gamsii*	80289-9-69592
Camelot O	*copper octanoate*	67702-2-67690
Cueva Fungicide Concentrate	*copper octanoate*	67702-2-70051
Double Nickel 55 Biofungicide	*Bacillus amyloliquefaciens str. D747*	70051-108
Double Nickel LC Biofungicide	*Bacillus amyloliquefaciens str. D747*	70051-107
EcoMate ARMICARB 0	*potassium bicarbonate*	5905-541
Microthiol Disperss	*sulfur*	70506-187
MycoStop	*Streptomyces griseoviridis*	64137-5
Mycostop Mix	*Streptomyces griseoviridis*	64137-9
OxiDate 2.0	*hydrogen dioxide, peroxyacetic acid*	70299-12
Oxidate Broad Spectrum	*hydrogen dioxide*	70299-2
PERpose Plus	*hydrogen peroxide/dioxide*	86729-1
Prestop Biofungicide	*Gliocladium catenulatum str. J1446*	64137-11
Regalia Biofungicide	*Reynoutria sachalinensis*	84059-3
RootShield PLUS+ Granules	*Trichoderma harzianum str. T-22, Tricoderma virens str. G-41*	68539-10
RootShield PLUS+ WP	*Trichoderma harzianum str. T-22, Tricoderma virens str. G-41*	68539-9
Serenade Soil	*Bacillus subtilis*	69592-12
Sporatec	*rosemary, clove, thyme oil*	Exempt - 25(b) pesticide
SoilGard	*Gliocladium virens str. GL-21*	70051-3
Taegro Biofungicide	*Bacillus subtilis*	70127-5
Trilogy	*neem oil*	70051-2

Abbreviations and Symbols Used in This Publication

A	acre	NE	not effective
AG	agricultural use label	NI	no information
AR	annual rye	NFT	not frost tolerant
ASO	aqueous suspension-organic	P	phosphorus
AS	aqueous suspension	PHI	pre-harvest interval
DF	dry flowable	P_2O_5	phosphorus oxide
EC	emulsifiable concentrate	PR	perennial rye
F	flowable	R	resistant varieties
HC	high concentrate	REI	restricted-entry interval
K	potassium	WP	wettable powder
K_2O	potassium oxide	WG	water dispersible granular
N	nitrogen	WPS	Worker Protection Standard

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