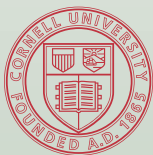


2016

Organic Production and IPM Guide for Peas



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2016 PRODUCTION GUIDE FOR ORGANIC PEAS FOR PROCESSING

Coordinating Editor

Abby Seaman* (NYS IPM Program)

Contributors and Resources

George S. Abawi (Cornell University, Section of Plant Pathology and Plant Microbe Biology, retired)

Ann Cobb (Cornell University, Section of Plant Pathology and Plant Microbe Biology, retired)

Helene Dillard (Dean of the College of Agricultural and Environmental Sciences at UC Davis, formerly Cornell University, Section of Plant Pathology and Plant-Microbe Biology)

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

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

Robert Hadad (Cornell Vegetable Program)

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

Julie Kikkert (Cornell Vegetable Program)

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

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

Brian Nault* (Cornell University, Department of Entomology)

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

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

**Pesticide Information and Regulatory Compliance*

Staff Writers

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

Editing for the 2016 update

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

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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 (June 2016). Changes in pesticide registrations and regulations, occurring after publication are available in county Cornell Cooperative Extension offices or from the Pesticide Management Education Program web site (<http://pmep.cce.cornell.edu>). Trade names used herein are for convenience only. No endorsement of products is intended, nor is criticism of unnamed products implied.

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

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

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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 Development/Assistance](#) web page (Link 5). See more certification and regulatory details under Section 4.1 and Section 10: *Using Organic Pesticides*.

1.2 Organic System Plan

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

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

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

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

2. SOIL HEALTH

Healthy soil is the basis of organic farming. Regular additions of organic matter in the form of cover crops, compost, or manure create a soil that is biologically active, with good structure and capacity to hold nutrients and water (note that any raw manure applications should occur at least 120 days before harvest). Decomposing plant materials will 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 crop or crops 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 knot 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).

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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.

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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
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

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

From NRAES publication [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	<i>Sclerotinia trifoliorum</i> increase	Both of these closely related diseases (varieties of <i>Sclerotinia trifoliorum</i>) 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

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[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.

Processing Pea Varieties	Fusarium Wilt Resistance	Root Rot Severity		Days to maturity	Vine Type	Comment
		Trial 1	Trial 2			
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. Planting dates are earlier on Long Island. 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 than 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, sufficient soluble nutrients must be available from the soil to meet the minimum requirements for the whole plant. The total nutrient needs of a crop are much higher than just the nutrients

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

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

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

Some soils are naturally high in P and K, or have a history of manure applications that have resulted in elevated levels. Regular soil testing helps monitor nutrient levels, in particular phosphorus (P) and potassium (K). Choose a reputable soil-testing lab (Table 8.0.1) and use it consistently to avoid discrepancies caused by different soil extraction

methods. Maintaining a soil pH between 6.3 and 6.8 will maximize the availability of all nutrients to plants.

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

Table 8.0.1 Nutrient Testing Laboratories.

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

8.1 Fertility

Recommendations from the [Cornell 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.

Develop a plan for estimating the amount of nutrients that will be released from soil organic matter, cover crops, compost, and manure. A strategy for doing this is outlined in Section 8.2: *Preparing an Organic Nutrient Budget*. It is important to remember that in cool soils, microorganisms are less active, and nutrient release may be too slow to meet the crop needs. Once the soil

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

8.2 Preparing an Organic Nutrient Budget

To create a robust organic fertility management plan, develop a plan for estimating the amount of nutrients that will be released from soil organic matter, cover crops, compost, and manure. As these practices are integrated into field and farm management, the goal is to support diverse microbial communities that will help release nutrients from the organic matter additions.

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. Included in the Soil Health Test is an analysis of soil protein content. As with the other soil health tests, this serves as an indicator of soil management and amendment history. The test measures organic soil N that is in the form of proteins- an important food source for soil microbes. Use this test to help monitor impact and target future investments of legume cover crops and compost / manure applications.

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 8.2.3 estimates common nutrient content in animal manures; however actual compost and manure nutrient content should be tested just prior to application. Analysis of other amendments, as well as cover crops, can be estimated using published values (see

Tables 8.2.4 to 8.2.6 and 3.1 for examples). Keeping records of these nutrient inputs and subsequent crop performance will help evaluate if the plan is providing adequate fertility during the season to meet production goals.

Table 8.2.1 Calculating Nutrient Credits and Needs.

	Nitrogen (N) lbs/A	Phosphate (P ₂ O ₅) lbs/A	Potash (K ₂ O) 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

Level shown in soil test	Soil Phosphorus Level			Soil Potassium Level		
	low	med	high	low	med	high
	P ₂ O ₅ lbs/A			K ₂ O 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.

So, for an application rate of 100 lbs. of N as manure, in year one 50 lbs. would be available, 25 lbs. in year 2, and

12.5 lbs. in year 3. Remember to check with your certifier on the days-to-harvest interval when using raw manure and allow a minimum of 120 days between application and harvesting. Enter estimated phosphorous additions and be aware that some manures have high phosphorous content (Table 8.2.3).

Line 3c. Compost: Estimate that between 10 and 25% of the N, 80% of the phosphorous and 90% of the potassium contained in most compost is available to the crop the first year. It is important to test each new mix of compost for actual amounts of the different nutrients available. 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, tillth, and nutrient retaining capacity. Also keep in mind that manure-based composts are potentially high in salts that could become a problem if used yearly. Most compost analyses include a measure of electrical conductivity which indicates level of salts present in the finished product. Any compost applied on organic farms must be approved for use by your farm certifier. Compost generated on the farm must follow an approved process outlined by your certifier.

Line 3d. Cover Crops: Estimate that 50 percent of the fixed N is released for plant uptake 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 nutrient values from soil organic matter, compost, and cover crops to estimate the total nutrient supplying potential of the soil (see example below). There is no guarantee that these amounts will actually be available in the season, since soil temperatures, water, and crop physiology all impact the release and uptake of these soil nutrients. If the available N does not equal the minimum requirement for this crop (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 25%, to help reduce some of the risk of N being limiting to the crop.

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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 ₂ O ₅	K ₂ O	N1	N2	P ₂ O ₅	K ₂ O
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

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

^a Application rates for some materials are multiplied to adjust for their slow to very slow release rates.

Table 8.2.5 Available Phosphorous in Organic Fertilizers.

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

^a Application rates for some materials are multiplied to adjust for their slow to very slow release rates.

Table 8.2.6 Available Potassium in Organic Fertilizers.

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

^a Application rates for some materials are multiplied to adjust for their slow to very slow release rates. Tables 8.3 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 P₂O₅ and 40 lb K₂O/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 ₂ O ₅) lbs/acre	Potash (K ₂ O) 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.

Additional Resources

- [Using Organic Nutrient Sources](#) (Link 26a)
- [Determining Nutrient Applications for Organic Vegetables](#) (Link 26b)

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) 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](#) (Link 39).
- [Calibrating Backpack Sprayers](#) (Link 40).
- [Pesticide Environmental Stewardship: Calibration](#) (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.
- [Pesticide Environmental Stewardship, Coop Extension](#) (Link 44)
- [Pesticide Environmental Stewardship, CIPM website](#) (Link 45)
- [Vegetable Spraying](#) (Link 46)

10.2 Regulatory Considerations

Organic production focuses on cultural, biological, and mechanical techniques to manage pests on the farm, but in some cases pesticides, which include repellents, allowed for organic production are needed. Pesticides mentioned in this organic production guide are registered by the United States Environmental Protection Agency (EPA) or meet the EPA requirements for a “minimum risk” pesticide. At the time of publication, the pesticides mentioned in this guide meet New York State Department of Environmental Conservation (NYS

DEC) requirements for use in New York State. See Cornell's [Product, Ingredient, and Manufacturer System](#) website (Link 2) for pesticides currently registered for use in NYS. Additional products may be available for use in other states.

To maintain organic certification, products applied must also comply with the National Organic Program (NOP) regulations as set forth in [7 CFR Part 205, sections 600-606](#) (Link 47). The [Organic Materials Review Institute \(OMRI\)](#) (Link 3) is one organization that reviews products for compliance with the NOP regulations and publishes lists of compliant products, but other entities also make product assessments. Organic growers are not required to use only OMRI listed materials, but the list is a good starting point when searching for allowed pesticides.

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

Note that "home remedies" may not be used. Home remedies are products that may have properties that reduce the impact of pests. Examples of home remedies include the use of beer as bait to reduce slug damage in strawberries or dish detergent to reduce aphids on plants. These materials are not regulated as pesticides, are not exempt from registration, and are therefore not legal to use.

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

Worker Protection Standard training. If the farm has employees who will be working in fields treated with a pesticide, they must be trained as workers or handlers as required by the federal Worker Protection Standard (WPS). Having a pesticide applicator certification is one of the qualifications needed to be a WPS trainer. Certified pesticide applicators meet the

WPS training requirements. For more information on the Worker Protection Standard see: [How To Comply with the Worker Protection Standard](#) (Link 48). See [Revisions To the Worker Protection Standard](#) for a summary of new worker protection standards that will take effect January 2017 (Link 48a). Find more information on pesticide applicator certification from the list of [State Pesticide Regulatory Agencies](#) (Link 49), or, in New York State, see the [Cornell Pesticide Management Education Program](#) (Link 50) website.

10.3 Pollinator Protection

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

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

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

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

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

For more information on pollinator protection, visit www.epa.gov/opp00001/ecosystem/pollinator/index.html and

pesticidestewardship.org/PollinatorProtection/Pages/default.aspx

10.4 Optimizing Pesticide Effectiveness

Information on the effectiveness of a particular pesticide against a given pest can sometimes be difficult to find. Some university researchers include pesticides approved for organic production in their trials; some manufacturers provide trial results on their web sites; some farmers have conducted trials on their own. Efficacy ratings for pesticides listed in this guide were summarized from university trials and are only provided for some products. The [Resource Guide for Organic Insect and Disease Management](#) (Link 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. Microbial-based products often have a shorter shelf life than other products, so be sure to use them by the expiration date. Read the pesticide label carefully to determine if water pH or hardness will negatively impact the pesticide's effectiveness. Use of a surfactant may improve organic pesticide performance. [OMRI lists adjuvants](#) on their website (Link 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. The use of pheromone traps or other monitoring or prediction techniques can provide an early warning for pest problems, and help effectively focus scouting efforts. When using pesticides, be sure you have sufficient coverage to provide adequate control. Consult the pesticide label for guidance.

11. DISEASE MANAGEMENT

In organic systems, cultural practices form the basis of a disease management program. Promote plant health by maintaining a biologically active, well-structured, adequately drained and aerated soil that supplies the requisite amount and balance of nutrients. Choose varieties resistant to one or more important diseases whenever possible (see Section 6). 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 crop or crops 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

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to keep the microbes alive. Follow label instructions carefully to achieve the best results.

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

Organic 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).

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Table 11.0 Pesticides for Disease Control in Organic Peas

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

CLASS OF COMPOUND Product name (Active ingredient)	Seed Decay/Root Rot	Fusarium Wilt	Leaf Spot	Powdery Mildew
MICROBIAL				
Actinovate AG (<i>Streptomyces lydicus</i>)	X			
Actinovate STP (<i>Streptomyces lydicus</i>)	X			
BIO-TAM (<i>Trichoderma asperellum</i> , <i>Trichoderma gamsii</i>)	X			
BIO-TAM 2.0 (<i>Trichoderma asperellum</i> , <i>Trichoderma gamsii</i>)	X			
Double Nickel 55 Biofungicide (<i>Bacillus amyloliquefaciens</i> str. D747)	X			
Double Nickel LC Biofungicide (<i>Bacillus amyloliquefaciens</i> str. D747)	X			X
MycoStop (<i>Streptomyces griseoviridis</i>)	X	X		
MycoStop Mix (<i>Streptomyces griseoviridis</i>)	X	X		
Prestop (<i>Gliocladium catenulatum</i> str. J1446)	X	X		
Regalia Biofungicide (<i>Reynoutria sachalinensis</i>)	X			X
RootShield Granules (<i>Trichoderma harzianum</i> str. T-22)	X			
RootShield PLUS+ Granules (<i>Trichoderma harzianum</i> str. T-22, <i>Trichoderma virens</i> str. G-41)	X			
RootShield PLUS+ WP (<i>Trichoderma harzianum</i> str. T-22, <i>Trichoderma virens</i> str. G-41)	X			
Serenade Soil (<i>Bacillus subtilis</i> str QST 713)	X			
SoilGard (<i>Gliocladium virens</i> str. GL-21)	X			
Taegro Biofungicide (<i>Bacillus subtilis</i>)	X			
BOTANICAL				
Trilogy (neem oil)			X	X
COPPER				
Basic Copper 53 (basic copper sulfate)				X
Cueva Fungicide Concentrate (copper octanoate)			X	X
OTHER				
Kaligreen (potassium bicarbonate)				X
Microthiol Disperss (sulfur)			X	X
OxiDate 2.0 (hydrogen dioxide, peroxyacetic acid)	X			
PERpose Plus (hydrogen peroxide/dioxide)	X		X	X
TerraClean 5.0 (hydrogen dioxide, peroxyacetic acid)	X			

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

🐝 Active ingredient meets EPA criteria for acute toxicity to bees

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
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ORGANIC PEA PRODUCTION

Management Option	Recommendations for Seed Decay and Root Rot Diseases
Scouting/thresholds	Choose healthy and well-drained soils. A soil Bio-Assay procedure that differentiates relatively pathogen-free fields from those with severe root rot problems is available. See the Bean Root Bio links at Cornell Comprehensive Assessment of Soil Health website (Link 11) for directions to do this yourself or to send a sample to Cornell for testing.
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 were available in New York State for managing this pest and were allowable for organic production. Listing a pest on a pesticide label does not assure the pesticide's effectiveness. The registration status of pesticides can and does change. Pesticides must be currently registered with the New York State Department of Environmental Conservation (DEC) to be used legally in NY. However, pesticides meeting the federal requirements for minimum-risk (25(b)) pesticides do not require registration. Current NY pesticide registrations can be checked on the Pesticide Product, Ingredient, and Manufacturer System ([PIMS](#)) website (Link 2). ALWAYS CHECK WITH YOUR CERTIFIER before using a new product.

Table 11.1 Pesticides for Management of Seed Decay and Root Rot Diseases					
Class of Compounds Product Name (Active Ingredient)	Product Rate	PHI ² (Days)	REI (Hours)	Efficacy	Comments
Actinovate AG (<i>Streptomyces lydicus</i> WYEC 108)	3-12 oz/acre soil treatment	0	1 or until dry	3	Not labeled for Thielaviopsis. <i>Streptomyces lydicus</i> products effective in 0/6 trials.
Actinovate STP (<i>Streptomyces lydicus</i>)	4-32 oz/ cwt seed seed treatment	-	1 or until dry	3	Actinovate STP effective in 0/1 study
BIO-TAM (<i>Trichoderma asperellum</i> , <i>Trichoderma gamsii</i>)	1.5-3 oz./ 1000 row feet in-furrow treatment 2.5-3 lb/ treated acre band	-	1	?	
Bio-Tam 2.0 (<i>Trichoderma asperellum</i> , <i>Trichoderma gamsii</i>)	2.5-5 lb/acre	-	4	?	
Double Nickel 55 (<i>Bacillus amyloliquefaciens</i> strain D747)	0.125-1lb./ treated acre soil treatment	0	4	?	Not labeled for Thielaviopsis.
Double Nickel LC (<i>Bacillus amyloliquefaciens</i> strain D747)	0.5-4.5 pts/ treated acre soil treatment	0	4	?	Not labeled for Thielaviopsis.
Mycostop (<i>Streptomyces grievoviridis</i> strain K61)	0.07 oz/ 100-200 ft ² soil treatment 0.07 oz/ lb seed seed treatment	-	4	?	Irrigate within 6 hours after soil spray or drench with enough water to move Mycostop into the root zone.
Mycostop Mix (<i>Streptomyces grievoviridis</i> strain K61)	5-8 oz/ cwt seed	-	4	3	Mycostop Mix effective in 0/1 study. Apply to seeds as planter box treatment.

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

Class of Compounds Product Name (Active Ingredient)	Product Rate	PHI² (Days)	REI (Hours)	Efficacy	Comments
Oxidate 2.0 (hydrogen dioxide, peroxyacetic acid)	1/2-1 gal/acre in-furrow treatment	0	until dry	?	At planting or in-furrow just prior to seed drop. Bee Hazard. This product is toxic to bees exposed to direct contact.
PERpose Plus (hydrogen peroxide)	1 fl.oz./ gal soil drench	-	until dry	?	Soil drench at time of seeding or transplanting.
Prestop (<i>Gliocladium catenulatum</i>)	1.4-3.5 oz/ 2.5 gal water soil drench	-	0	?	Treat only the growth substrate when above-ground harvestable food commodities are present.
Regalia (<i>Reynoutria sachalinensis</i>)	1-4 qt/acre in-furrow treatment	0	4	?	Not labeled for Thielaviopsis.
RootShield Granules (<i>Trichoderma harzianum</i>)	2.5-6 lb/half acre in-furrow treatment	-	0	3	Trichoderma harzianum products effective in 0/2 trials.
RootShield PLUS+ Granules (<i>Trichoderma harzianum</i> , <i>Trichoderma virens</i>)	2.5-6 lb/half acre in-furrow treatment	-	0	3	Trichoderma harzianum products effective in 0/2 trials.
RootShield PLUS+ WP (<i>Trichoderma harzianum</i> , <i>Trichoderma virens</i>)	16-32 oz/acre	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. In furrow spray or transplant starter solution.
Serenade Soil ¹ (<i>Bacillus subtilis</i> str QST 713)	2-6 qt/acre soil treatment	0	4	3	Serenade Soil drench effective in 0/1 study. Not labeled for Thielaviopsis.
Soilgard (<i>Gliocladium virens</i>)	2-10 lb/acre	-	0	?	Used as a directed spray or drench at the base of the plant after transplanting.
Taegro (<i>Bacillus subtilis</i>)	3 tsp/gal seed treatment	-	24	?	Not labeled for Thielaviopsis. For seed treatment, allow seeds to soak for 10-30 minutes.
Taegro (<i>Bacillus subtilis</i>)	2.6 oz/100 gal water in-furrow treatment	-	24	?	Not labeled for Thielaviopsis. Water-in with at least 0.1 inch of water. Soil drench or over furrow at time of planting.
TerraClean 5.0 (hydrogen dioxide, peroxyacetic acid)	128 fl oz/100 gal water soil treatment	up to day	0	?	Soil treatment prior to seeding/transplanting.

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

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

Table 11.2 Pesticides for Management Fusarium Wilt					
Class of Compounds Product Name (Active Ingredient)	Product Rate	PHI ² (Days)	REI (Hours)	Efficacy	Comments
MycoStop (<i>Streptomyces grieviridis</i> str K61)	0.07 oz/ lb seed seed treatment 0.07 oz/100-200 sq ft soil treatment	-	4	?	Irrigate within 6 hours after soil spray or drench with enough water to move Mycostop into the root zone.
MycoStop Mix (<i>Streptomyces grieviridis</i> str K61)	5-8 oz/ cwt seed 7.6-30 oz/acre soil treatment	-	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.
MycoStop Mix (<i>Streptomyces grieviridis</i> str K61)	0.5-1 lb/treated acre soil treatment	-	4	?	Lightly incorporate furrow or band applications.
Prestop (<i>Gliocladium catenulatum</i>)	1.4-3.5 oz/ 2.5 gal water soil drench	-	0	?	Treat only the growth substrate when above-ground harvestable food commodities are present.

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. ²Note that when the REI is longer than the PHI, Worker Protection Standard requirements may necessitate waiting until after REI to harvest.

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

Table 11.3 Pesticides for Management of Ascochyta Leaf Spot					
Class of Compounds Product Name (Active Ingredient)	Product Rate	PHI ² (Days)	REI (Hours)	Efficacy	Comments
Cueva Fungicide Concentrate (copper octanoate)	0.5-2 gal/acre	up to day	4	?	
Microthiol Disperss (sulfur)	3-10 lb/acre	-	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.)
PERpose Plus (hydrogen peroxide)	1 fl oz/ gal (initial/curative)	-	until dry	?	For initial or curative use, apply higher rate for 1 to 3 consecutive days. Then follow with weekly/preventative treatment.
PERpose Plus (hydrogen peroxide)	0.25-33 fl oz/ gal (weekly/preventative)	-	until dry	?	For weekly or preventative treatments, apply lower rate every five to seven days. At first signs of disease, use curative rate then resume weekly preventative treatment.
Trilogy (neem oil)	0.5-1% in 25-100 gal of water/acre	up to day	4	?	Limited to a maximum of 2 gal of Trilogy/acre/application. Bee Hazard. This product is toxic to bees exposed to direct contact.

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. ²Note that when the REI is longer than the PHI, Worker Protection Standard requirements may necessitate waiting until after REI to harvest.

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11.4 Powdery Mildew, *Erysiphe pisi*

Time for concern: Most likely to occur in late spring and all plantings.


Key characteristics: typical white powdery fungal growth develops on leaves and stems. This growth is faint on pods. Russet symptoms develop on affected pods.

Management Option	Recommendations for Powdery Mildew
Scouting/thresholds	Record the occurrence and severity of powdery mildew. No thresholds have been established.
Resistant varieties	Select resistant varieties.
Crop rotation	One-year rotation recommended.
Seed selection/treatment	Pathogen can be seed-borne, but not considered an important source of the pathogen.
Chemical	See Cornell article for more information about applying copper fungicides, and for a comparison of the quantity of copper in products approved for organic production. https://blogs.cornell.edu/livegpath/files/2015/04/Organic-copper-fungicides_2014-1da8n4e.pdf

Table 11.4 Pesticides for Management of Powdery Mildew

Class of Compounds Product Name (Active Ingredient)	Product Rate	PHI ² (Days)	REI (Hours)	Efficacy	Comments
Basic Copper 53 (basic copper sulfate)	1.5 lb/acre	up to day	48	?	Copper products are not effective as stand-alone materials.
Cueva Fungicide Concentrate (copper octanoate)	0.5-2 gal/acre	up to day	4	?	Copper products are not effective as stand-alone materials.
Kaligreen (potassium bicarbonate)	2.5-3 lbs/acre	1	4	?	Apply 7-10 day intervals.
Microthiol Disperss (sulfur)	3-10 lb/acre	-	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.)
PERpose Plus (hydrogen peroxide)	1 fl oz/ gal (initial/curative)	-	until dry	?	For initial or curative use, apply higher rate for 1 to 3 consecutive days. Then follow with weekly/preventative treatment.
PERpose Plus (hydrogen peroxide)	0.25-33 fl oz/ gal (weekly/preventative)	-	until dry	?	For weekly or preventative treatments, apply lower rate every five to seven days. At first signs of disease, use curative rate then resume weekly preventative treatment.
Trilogy (neem oil)	0.5-1% in 25-100 gal water/acre	up to day	4	?	Limited to a maximum of 2 gal of Trilogy/acre/application.

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.. ²Note that when the REI is longer than the PHI, Worker Protection Standard requirements may necessitate waiting until after REI to harvest.

 Active ingredient meets EPA criteria for acute toxicity to bees

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. See Cornell fact sheets about [root knot](#) (Link 31) and [root lesion](#) (Link 32) nematodes.

Management Option	Recommendation for Nematodes
Scouting/thresholds	<p>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 analysis at a public or private nematology lab (Link 29). See</p> <p>Section 4: Field Selection for more information, as well as the following Cornell publications for instructions:</p> <p>Soil Sampling for Plant-Parasitic Nematode Assessment (Link 30).</p> <p>Visual Assessment of Root-Knot Nematode Soil Infestation Levels Using a Lettuce Bioassay (Link 31).</p> <p>A Soil Bioassay for the Visual Assessment of Soil Infestations of Lesion Nematode (Link 32).</p>
Resistant varieties	No resistant varieties are available.
Crop rotation	<p>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.</p>
Site selection	Assay soil for nematode infestation, if needed.
Cover crops	<p>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.</p>

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Management Option	Recommendation for Nematodes
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.

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Table 12.1 Pesticides for Management of Nematodes

Class of Compounds Product Name (Active Ingredient)	Product Rate	PHI ² (Days)	REI (Hours)	Efficacy	Comments
DiTera DF (<i>Myrothecium verrucaria</i>)	13-100 lb/acre soil treatment	-	4	?	
Ecozin Plus 1.2% ME (azadirachtin)	25-56 oz/acre soil drench	0	4	?	
Molt-X (azadirachtin)	15 oz/acre soil treatment	0	4	?	Apply in sufficient amount of water to penetrate in the soil to a depth of 12 inches. Repeat applications every 3 or 4 weeks or as needed.

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. 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. ²Note that when the REI is longer than the PHI, Worker Protection Standard requirements may necessitate waiting until after REI to harvest.

 Active ingredient meets EPA criteria for acute toxicity to bees

13. 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.

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).

Efficacy

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.

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

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. ²Note that when the REI is longer than the PHI, Worker Protection Standard requirements may necessitate waiting until after REI to harvest.

Active ingredient meets EPA criteria for acute toxicity to bees

14. 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 Cornell [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.

ORGANIC PEA PRODUCTION

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Table 13.1 Pesticides for Management of Slugs

Class of Compounds Product Name (Active Ingredient)	Product Rate	PHI ² (Days)	REI (Hours)	Efficacy	Comments
BioLink (garlic juice)	0.5-2 qt/acre	-	-	?	25(b) pesticide. Repellant.
BioLink Insect & Bird Repellant (garlic juice)	0.5-4 qt/acre	-	-	?	25(b) pesticide. Repellant.
Bug-N-Sluggo (☞ spinosad, iron phosphate)	20-44 lb/acre Soil treatment	3	4	?	
Garlic Barrier AG (garlic juice)	1 gal/ 99 gal water mix	-	-	?	25(b) pesticide. Repellant.
Sluggo AG (iron phosphate)	20-44 lb/acre Soil treatment	0	0	1	Effective in 1 trial.
Sluggo Slug and Snail Bait (iron phosphate)	20-44 lb/acre Soil treatment	0	0	?	

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. ²Note that when the REI is longer than the PHI, Worker Protection Standard requirements may necessitate waiting until after REI to harvest.

☞ Active ingredient meets EPA criteria for acute toxicity to bees

15. PESTICIDES AND ABBREVIATIONS MENTIONED IN THIS PUBLICATION

Table 1. Insecticides, Nematicides and Molluscicides

TRADE NAME	COMMON NAME	EPA REG. NO.
AZA-Direct	☞ azadirachtin	71908-1-10163
AzaSol	☞ azadirachtin	81899-4
BioLink	garlic juice	Exempt - 25(b) pesticide
BioLink Insect & Bird Repellant	garlic juice	Exempt - 25(b) pesticide
Bug-N-Sluggo	iron phosphate and ☞ spinosad	67702-24-70051
DiTera DF	<i>Myrothecium verrucaria</i>	73049-67
Ecozin Plus 1.2% ME	☞ azadirachtin	5481-559
Garlic Barrier	garlic juice	Exempt - 25(b) pesticide
Molt-X	☞ azadirachtin	68539-11
Sluggo AG	iron phosphate	67702-3-54705
Sluggo Slug and Snail Bait	iron phosphate	67702-3-70051

☞ Active ingredient meets EPA criteria for acute toxicity to bees


Table 2. Fungicides

TRADE NAME	COMMON NAME	EPA REG. NO.
Actinovate AG	<i>Streptomyces lydicus</i> WYEC 108	73314-1
Actinovate STP	(<i>Streptomyces lydicus</i>)	73314-4
Basic Copper 53	basic copper sulfate	45002-8
BIO-TAM	<i>Trichoderma asperellum</i> , <i>Trichoderma gamsii</i>	80289-9-69592
BIO-TAM 2.0	(<i>Trichoderma asperellum</i> , <i>Trichoderma gamsii</i>)	80289-9
Cueva Fungicide Concentrate	copper octanoate	67702-2-70051
Double Nickel 55 Biofungicide	<i>Bacillus amyloliquefaciens</i> str. D747	70051-108
Double Nickel LC Biofungicide	<i>Bacillus amyloliquefaciens</i> str. D747	70051-107

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Table 2. Fungicides

TRADE NAME	COMMON NAME	EPA REG. NO.
Kaligreen	<i>potassium bicarbonate</i>	11581-2
Microthiol Dispers	<i>sulfur</i>	70506-187
Mycostop	<i>Streptomyces griseoviridis</i>	64137-5
Mycostop Mix	<i>Streptomyces griseoviridis</i>	64137-9
OxiDate 2.0	<i>hydrogen dioxide, peroxyacetic acid</i>	70299-12
PERpose Plus	<i>hydrogen peroxide/dioxide</i>	86729-1
Prestop Biofungicide	<i>Gliocladium catenulatum str. J1446</i>	64137-11
Regalia Biofungicide	<i>Reynoutria sachalinensis</i>	84059-3
RootShield Granules	<i>Trichoderma harzianum str. T-22</i>	68539-3
RootShield PLUS+ Granules	<i>Trichoderma harzianum str. T-22,</i> <i>Tricoderma virens str. G-41</i>	68539-10
RootShield PLUS+ WP	<i>Trichoderma harzianum str. T-22,</i> <i>Tricoderma virens str. G-41</i>	68539-9
Serenade Soil	<i>Bacillus subtilis str. QST 713</i>	69592-12 and 264-1152
SoilGard	<i>Gliocladium virens str. GL-21</i>	70051-3
Taegro Biofungicide	<i>Bacillus subtilis</i>	70127-5
TerraClean 5.0	<i>hydrogen dioxide, peroxyacetic acid</i>	70299-13
Trilogy	<i>neem oil</i>	70051-2

 Active ingredient meets EPA criteria for acute toxicity to bees

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 ₂ O 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 ₂ O	potassium oxide	WG	water dispersible granular
N	nitrogen	WPS	Worker Protection Standard

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