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Organic Production of Garlic, Onions, and Other Alliums

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This publication introduces different types of culinary alliums suited to organic production. It briefly covers production considerations, harvest, and storage. It also discusses Integrated Pest Management principles for alliums, including weed control, problematic insects and mites, and several allium diseases.

Photo: Carl Tronders

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Introduction

Garlic and onions are biennial monocotyledons (having a life span of two years) of the Liliaceae family and the *Allium* genus. They are generally grown as annuals and are cool-season crops that require temperatures of at least 55°F to emerge from seed. Optimal leaf growth rates occur at temperatures of 68°F to 77°F (Adam, 2006). Alliums include various bulbing and non-bulbing species and are used for both culinary and ornamental purposes. This publication focuses on culinary allium, such as garlic and onions.

Onions, *Allium cepa,* are classified as dried (bulb) or green. Bulb onion varieties are generally classified by day length (short, intermediate, long), market use (fresh bulb, dehydrator bulb, or storage type) and bulb color within the fresh-market class. Sweet onion types are most often marketed as fresh bulbs. In general, short-day onions are suitable for the southern part of the country; long-day onions are ideal for northern onion-growing regions. Intermediate-day onion varieties are more adaptable to California and the central United States, as they require 12 to 14 hours of sunlight before starting the bulb formation process. The extreme northern and southern regions of the country (e.g., Maine, Texas, Florida) can have difficulties with intermediate-day onion production. With sufficient hours of light, they will typically yield good-sized bulbs.

Green onions are harvested while the tops are still green and usually before the bulb has formed. They may be produced from immature, thickly planted white onion varieties of *Allium cepa* and from *Allium fistulosum* (commonly known as Japanese bunching types). Some markets exist for green onions with small bulbs.

Shallots, *Allium cepa 'aggregatum',* have a delicate onion flavor with a touch of garlic. They are propagated by cloves like garlic or by seed like onions. Shallots produce a cluster of small, pointed bulbs from a single planted bulb. The bulbs can be of varying colors: red, yellow, or gray.

Leeks, *Allium ampeloprasum,* require a cool-to-moderate climate and a growing season of 80 to 100 days (Lang, 2023). They are more popular in Europe than in the Americas, but their sweet taste with a subtle onion flavor and soft, silky textures when cooked make them a favorite of chefs and restaurants.

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Organic Production

Organic production of garlic and onion crops, or any agricultural product, depends on management techniques that replenish and maintain long-term soil fertility by optimizing soil biological activity. This is achieved through crop rotation, cover crops, composting, and the use of organic fertilizers that feed the soil while providing nutrients to the plants. In addition to producing high-quality crops, healthy and well-balanced soil can help plants develop natural resistance to insect pests and diseases. When pest controls are needed, organic farmers manage insects, diseases, weeds, and other pests with cultural, mechanical, biological, and—as a last resort—biorational and chemical controls that are acceptable under the national organic standards.

Although anyone can grow organically, if you plan to label and market your products as organic, you will need to be certified by a USDA-accredited certifier. For more information on organic production and certification go to ATTRA's Organic Farming topic area.

Soil Fertility

Members of the *Allium* genus (garlic and onions) grow in almost any type of soil with good drainage that is friable (easily crumbles in the hand), preferably with a high content of organic matter. High organic matter helps with water retention in the soil as well as drainage. These are important factors for crops, like alliums, that have shallow roots. If possible, begin soil preparation the year before planting. Take soil samples to determine the pH and nutrients needed. It is best to create healthy soil the previous season using cover crops and compost before planting garlic and onions. See the resources on fertilization and compost available in the Soil section of the ATTRA website.

Additional nitrogen may be necessary, added by means of organic fertilizers. Apply nitrogen after planting, or before transplanting if you use a slow-release fertilizer, such as fish or compost. Do not apply nitrogen when the bulbs are beginning to enlarge, as this will encourage excessive leaf growth and reduce the size of the bulb. Alliums can be fertilized in the fall and then in the spring through the irrigation system or side-dress dry

Related ATTRA Resources
ATTRA.NCAT.ORG

Topic Areas

- Organic Farming
- Soil
- Pest Management

ATTRA Publications

- A Pictorial Guide to Hedgerows for Beneficial Insects
- Soil Solarization and Biosolarization
- Sustainable Pest and Weed Control Database

Garlic – Not your typical *Allium*

Garlic is an *Allium*, but it has different growth and planting requirements than typical alliums. Garlic is started in the fall because it requires a cold period to form bulbs. It is propagated through the cloves, which in mid-summer form the classic bulb that people are familiar with. Garlic is not typically propagated by seed.

Garlic can be divided into two types: hard neck and soft neck. The neck refers to the stem, or pedicle, of the flower.

Hard-necked garlic, *Allium ophioscorodon*, produces elongated flower stalks, often referred to as scapes, and flower-like bulbils (small bulb) at the top of the stalk. Generally, hard-necked garlic varieties have four to 12 cloves that wrap the stem. Because of the hard neck of the stem, they are difficult to braid, may sprout roots, and dry within a few months after harvest.

Soft-necked garlic, *Allium sativum,* does not produce bulbils except in times of stress. These varieties are used in commercial production as they yield better, can be braided, and can be stored longer (six to eight months) than hard-necked varieties. Heads have 10 to 40 cloves that are arranged in layers.

Elephant garlic, *Allium ampeloprasum,* is not considered "true garlic" but is more related to the leek. Elephant garlic produces a very large bulb of cloves with a mild garlic taste. It is usually grown in the same way as hard-neck garlic, except that these large bulbs are planted further apart. It is most often grown for consumers who want a milder garlic or who need larger cloves.

material to the bed. Some farmers spray the leaves with liquid fish or seaweed fertilizers several times in the spring. If you supplement nutrients in that manner, do so before the fourth or fifth leaf and use a spreader sticker adjuvant that is allowed in organic production so that the solution is retained in the waxy leaves.

Planting

You can plant alliums by seed, transplants, cloves, or bulb sets, depending on the type you want to grow. Obtain propagation material from reliable sources that specialize in seeds or transplants, especially if you sow garlic or shallots, because they will provide you with material suitable for your region. If you use supermarket garlic cloves, for example, they are likely to be from another region and could be sprayed with sprout inhibitor.

Plant garlic in the autumn, as it requires a cold period for the bulb to divide into cloves. Other alliums can be planted with transplants in the spring.

Raised beds are desirable because they improve drainage and prevent compaction. The distance between rows can be 16 to 24 inches for onions, leeks, or shallots and 18 to 30 inches for garlic. The distance between plants varies according to class and variety but is usually 3 to 6 inches.

Mulch is frequently used in the production of organic garlic. It helps improve survival in winter, suppresses weeds, conserves soil moisture, and prevents soil erosion. It can also increase yields by keeping the soil cooler during warm summers.

Overwintering onions is a method of planting onion bulbs in the fall and allowing them to grow slowly during the winter months. This technique can have several benefits, including reduced labor and improved onion quality. When onion bulbs are planted in the fall, they have a longer growing season and more time to develop deep roots and strong foliage. This allows them to store more nutrients and water, which can lead to larger bulbs and better overall quality. Additionally, fall-planted onions require less labor than traditional spring planting methods. Because the onions are planted in the fall, there is no need to till the soil in the spring or prepare the seedbeds. This can save time and reduce labor costs for growers. Overwintering onions also have a reduced risk of certain pests and diseases, such as onion maggots and thrips, which can be more prevalent during the warm summer months. The cooler winter temperatures can also help to slow the growth of weeds, which can reduce the need for weed control.

However, there are also some potential drawbacks to overwintering onions. The winter months can be harsh, and if the onions are not planted correctly or protected from extreme cold, they may not survive. Additionally, overwintering onions require a longer growing season, which can delay the harvest and require more storage space for the mature bulbs.

Overall, overwintering onions can be an effective way to improve onion quality and reduce labor costs for growers. However, it is important to carefully consider the climate, soil conditions, and potential risks before deciding to use this planting method.

Plant garlic in the autumn, as it requires a cold period for the bulb to divide into cloves. Other alliums can be planted with transplants in the spring.

Irrigation

Alliums need a continuous supply of moisture when actively growing. It takes an inch of rain per week or the equivalent in irrigation (University of Massachusetts Extension, 2012). Drip irrigation saves water and fertilizers and reduces weeds and diseases. Stop irrigating for at least one to two weeks before harvesting.

Harvest and Storage

Harvesting and storing alliums requires special considerations to ensure quality for an extended period. Here are some tips to keep in mind:

- Harvesting: Alliums are ready for harvesting when the leaves start to yellow and wilt. Carefully pull the bulbs out of the ground and lay them out in a dry, sunny spot to cure for a few days. This allows the outer layers to dry and toughen, which helps protect the bulbs during storage.
- Cleaning: After curing, remove any loose dirt or debris from the bulbs. Be careful not to bruise or damage the bulbs, as this can lead to spoilage during storage.
- Sorting: Sort the bulbs by size and quality. Large, firm bulbs with tight skins will store the best, while smaller or damaged bulbs should be used first.

- Storage: Alliums should be stored in a cool, dry, and well-ventilated area to prevent them from sprouting or rotting. Avoid storing them in plastic bags or containers, as this can trap moisture and promote spoilage. Instead, use mesh bags, baskets, or cardboard boxes that allow for air circulation.
- Temperature: Alliums should be stored at a temperature between 32°F and 40°F, with a relative humidity of 60% to 70% (Newenhouse, 2011). Avoid storing them near fruits or vegetables that produce ethylene gas, as this can cause the alliums to sprout or spoil prematurely.

By following these guidelines, you can successfully harvest and store alliums for several months, ensuring quality of your crop.

Integrated Pest Management (IPM) is a broad ecological approach to pest management using a variety of pest-control techniques that target the entire pest complex of a crop ecosystem.

Integrated Pest Management

Integrated Pest Management (IPM) is a broad ecological approach to pest management using a variety of pest-control techniques that target the entire pest complex of a crop ecosystem. Integrated management of pests ensures high-quality agricultural production in a sustainable, environmentally safe, and economically sound manner.

IPM is based on the following components: pest identification, monitoring, mechanical and physical controls, cultural controls, biological controls, and chemical controls. For a detailed description of integrated pest management concepts, see the resources in ATTRA's Pest Management topic area.

Weeds

Weed control is the biggest challenge in the production of alliums. The shape and growth of these crops make them susceptible to being dominated by weeds, affecting yields and quality. The narrow, vertical leaves of allium crops do not compete well with weeds, and their long growing season allows successive generations of weeds. Weeding between the crop sacrifices many plants, reducing yields. Farmers must address this issue before planting to avoid the high cost associated with weeding. In conventional production, farmers rely on herbicides to control these weeds, but in organic production they must use other techniques.

The technique called *stale seedbed* reduces the seed bank in the soil by allowing weed seeds to germinate and emerge before the allium crop is planted. Once the weeds appear, they are easily removed by light cultivation, minimizing further soil disturbance. This cycle can be repeated numerous times before planting the crop. Early reduction of the amount of weed seedlings by this method reduces weeding frequency once the crop is established.

Crop rotation with cover crops can provide a variety of crop benefits, especially if the cover crop is cut in the fall, before planting garlic or onions. If cover crops are quickly established, many weeds will be suppressed. A high seed rate of the cover crop is an important factor in covering the soil and suppressing weeds. Vigorous cover crops that provide complete land cover in the first 30 days are very competitive and limit weed growth. Competitive species include cereal rye and mustards. Avoid slow-growing winter cover crops that include legumes and mixes of legumes and cereals.

Occultation is a weed-control method that consists of covering the soil with a sheet of black, opaque tarp for four to eight weeks before planting. Having moist soil under the plastic, combined with the heat generated by the non-transparent black surface, creates the conditions for germination of weed seeds, which are then impeded in their development by the absence of light. Once the seedlings expend their energy reserves in search of light, they wither and die.

The technique known as *solarization* consists of laying a transparent plastic cover on wet soil. Heat is trapped under the plastic, raising the soil temperature and killing or weakening the pests. Generally, this process of soil pasteurization takes four to six weeks, but the length of time depends on many factors, such as rain, wind, day length, soil texture, and polyethylene coverage quality. Plastic with protection against ultraviolet rays is recommended, so the cover can be removed and reused.

Anaerobic soil disinfestation (ASD) is a biological process that occurs when water-saturated soils are covered with plastic and have a source of organic matter incorporated into them. Microorganisms deplete oxygen and convert carbon into toxic fumigant. It is important to perform this process during the warmest time of the year. The ASD process is as follows:

- Spread organic matter (compost, green waste, or pomace) or incorporate a cover crop (the deeper the better).
- Form beds and place drip tape.
- Cover beds with plastic mulch with edges sealed with soil.
- Water with drip tape until the soil is saturated. It can also be watered with a sprinkler system before placing the plastic.
- Wait two to six weeks (depending on the climate, soil type, and whether it is necessary to repeat watering to reach anaerobic conditions).
- Remove the plastic or drill holes in the plastic, let aerate for a few days, then plant.

Biosolarization combines solarization with anaerobic soil disinfestation (ASD). Biosolarization takes one to two weeks compared to four to eight weeks for solarization and two to six weeks for ASD with black plastic. If applied correctly, biosolarization and ASD create temporary anaerobic conditions in the soil, stimulating anaerobic microorganisms to break down available carbon sources, producing organic acids, aldehydes, alcohols, ammonia, metal ions, and toxic or soil-suppressing volatile organic compounds. For more information on solarization and biosolarization, see the ATTRA publication *Soil Solarization and Biosolarization.*

Soil steaming is a method of sterilizing soil using steam to kill pathogens, pests, and weed seeds, which can improve the yield and quality of your allium crops. However, it is important to note that soil steaming can be expensive and requires specialized equipment, so it may not be feasible for all growers.

Insects and Mites

There are many insects and mites that feed on alliums and threaten quality and yields. Local Extension specialists are familiar with common pests in the area and can assist in their identification, which is the first step in pest management. A pest monitoring program can help producers determine the number of pests

Rows of garlic biosolarization during August and September 2021. Photos: Martin Guerena, NCAT and the presence of beneficial insects. Once the pest pressure reaches the economic threshold (where pest treatment is less costly than the losses incurred in not treating them), it becomes necessary to take control measures.

Beneficial insect habitats planted on the sides of the fields provide shelter and sources of pollen and nectar to predators and parasites of insect pests. They also give beneficial insects shelter when the fields are treated with pesticides. Cover crops also function as habitat when they bloom. For more information on beneficial insect habitat, consult the ATTRA publication *A Pictorial Guide to Hedgerows for Beneficial Insects*.

Biological control is the effect of natural enemies, such as parasites, pathogens, and predators, on pests.

Some problematic insects and mites for alliums are onion maggot, leafminer, thrips, and bulb mites. There are some cultural practices to minimize damage, as well as some biological controls, and, as a last option, biorational pesticide control. Biorational refers to the following types of pesticides: microbials, formulations of viruses, bacteria, fungi, or nematodes; plant-derived (botanical) pesticides and several types of pesticides, such as particle films, pheromones, and compounds such as Spinosad, that have low impacts on non-target organisms and degrade into non-toxic components. Some biorational pesticides are accepted in organic production and some may not be, so please confirm with your certifier that a particular product is accepted before applying it.

Onion Maggot

The onion maggot and the corn seed maggot cause similar damage in alliums. The larvae feed on shoots and young roots of the developing seedling. Seed maize worms feed on seeds and seedlings and can damage plants up to the third or fourth leaf stage. The first generation of onion maggots feeds mainly on seedlings up to the third to fifth leaf stage. The second and third generation feed during bulb expansion, which can increase bulb rot during storage (Turini et al., 2023).

Onion maggot (Delia antiqua). Photo: Pest and Diseases Image Library, Bugwood.org

Cultural practices are important to reduce maggot damage:

- Delay planting. Wait until late spring to avoid the first generations of flies.
- Rotate crops. Do not plant alliums in the same place for two years. Pupae hibernate in the ground.
- Use floating covers to protect the crop from flies. Place the mesh 6 inches from both sides of the planting line and anchor well.
- Remove and destroy residues from harvested alliums at the end of the season.

Biological control is the effect of natural enemies, such as parasites, pathogens, and predators, on pests. Some of these enemies can be attracted to plantings with flowering habitats, as mentioned above. Some are available commercially through agro-products distributors or the Internet. Onion worms are susceptible to the following biological controls:

- Beneficial nematodes *Steinernema carposporae* and *Steinernema feltiae,* which are more effective when applied in the morning or afternoon and released in moist soil
- Braconid wasps, ground beetles, and birds, which will parasitize or consume onion maggots

Search ATTRA's *Sustainable Pest and Weed Control Database* to find a formulation to manage specific pests. Biorational chemical controls that can manage the onion maggot fly are listed by their active ingredient (AI), since several commercial products contain these AI in their formulations. The database generates a list of commercial products with this ingredient and proves a link to the product website information (information pamphlets, labels, material safety data sheets). The AI listed for the control of onion maggot are: azadirachtin, pyrethrin, diatomaceous earth (silicon dioxide), fats and glyceridic oils of Margosa, and Spinosad. Remember to inform your organic certifier of the product you choose to determine if it is acceptable in organic production.

Thrips

Thrips are small insects that rasp and suck juices from leaves, causing damage to onions and other alliums. The onion thrips measures 1.3 mm, while the western flower thrips measures 1.5 mm (Miyao

Onion thrips (Thrips tabaci). Photo: Alton N. Sparks, Jr., University of Georgia, Bugwood.org

Leafminer damage on onion. Photo: Howard F. Schwartz, Colorado State University, Bugwood.org

et al., 2016). Both feed on alliums, causing scarring of the leaves and, in some cases, acting as virus vectors.

Cultural controls consist of planting resistant varieties, using sprinkler irrigation, and avoiding planting alongside other crops that are hosts of thrips, such as alfalfa and grains.

Biological controls include the minute pirate bug (*Orius* sp.), lacewings, and predatory mites.

Biorational insecticide controls include the following: Azadirachtin, sulfur, Spinosad, pyrethrin, diatomaceous earth (silicon dioxide), cinnamon oil, mineral oil, rosemary oil, neem oil, cotton oil, soybean oil, petroleum oil, thyme oil, fats and glyceridic oils of Margosa, *Sophora flavescens* plant extract, calcium polysulfide, potassium salts of fatty acids (soap), fatty acid ammoniate soap, ammonium nonanoate, kaolin clay, sabadilla alkaloids, *Steinernema feltiae* nematodes, and microbial insecticides: *Isaria fumosorosea* Apopka Strain 97 *(Paecilomyces fumosoroseus), Beauveria bassiana, Chromobacterium, Heterorhabditis bacteriophora, Metarhizium anisopliae, Paecilomyces fumosoroseus, Burkholderia spp.*

Leafminer

Adult leafminers are small black and yellow flies that pierce the leaf to feed on the sap and lay eggs within the leaf tissue. The larva causes serpentine mines in the foliage. The damage caused by leafminers is cosmetic; however, contamination by pupae and larvae is a marketing problem for green onions. Damage to dry onions and garlic is rarely a concern, unless leafminers become so numerous that they kill the foliage prematurely.

Cultural controls include complete tillage of a field previously planted with susceptible crops, then wait at least two weeks for the leafminer flies to emerge from pupae in the ground before planting alliums. Also, control the broadleaf weeds that may serve as hosts.

Biological control is possible with parasitic wasps, but they are susceptible to insecticides and may be unreliable if pesticides have been applied.

Biorational chemical controls include the following: azadirachtin, petroleum oil, Spinosad, pyrethrin, diatomaceous earth (silicon dioxide), mineral oil, fats and glyceridic oils of Margosa, neem oil, potassium salts of fatty acids (soap), oil, paraffinic oil, *Sophora flavescens* plant extract, kaolin clay, and microbial insecticides: *Isaria fumosorosea* Apopka Strain 97 *(Paecilomyces fumosoroseus).*

Bulb Mites

Two groups of mites can infest alliums bulbs; these are from the Acaridae and Eriophyidae families. Both groups of mites can infest onions and garlic both in the field and in storage. They can survive on decaying vegetation in the field until it completely decomposes. Bulb mites can slow plant growth and reduce the establishment of allium plantings. These mites also promote bulb rot in storage by exposing the bulbs to pathogens.

Several cultural controls are available:

- Recognize that flood irrigation or heavy rainfall can reduce the number of mites in the soil.
- Use only certified and clean seed cloves when planting garlic.

- Consider treating garlic seed cloves with hot water (130°F for 10 to 20 minutes) before planting (Dawling, 2020). Caution: this practice may reduce mite infestations but may also decrease germination.
- Soak the seeds in 2% soap (not detergent) and 2% mineral oil for 24 hours before planting.
- Dry the bulbs before storage to reduce light to moderate infestations.
- Avoid planting successive onion or garlic crops and rotate with crops that are less susceptible to damage from mites.
- Avoid planting onion or garlic immediately after brassica species, corn, grain, Sudan grass, or grass cover crops.

Most garlic diseases are transmitted by soil or seeds.

Chemical controls for mites are preventive and should be considered in fields that have a lot of vegetation and have had previous problems with mites. Complete decomposition of organic matter in the field before planting is key to controlling this pest. Some pesticide options are azadirachtin, sulfur, pyrethrin, diatomaceous earth (silicon dioxide), oils, and soap.

Diseases

Most garlic diseases are transmitted by soil or seeds. Reduce disease by practicing the following cultural practices:

- Plant certified, disease-free seed.
- Rotate crops with other species outside the Alliums and rotate fields with history of disease.
- Practice field sanitation: if there are yellowish or deformed leaves, remove them.
- Protect plants from injury (by insects and machinery).
- Dry the bulbs well and store them in a cool, dry place with low humidity, away from heat, frost, and strong sunlight at approximately 50°F to 70°F.
- Do not overwater or overfertilize.
- Do not plant in land with poor drainage.
- Wash the equipment well before and after working the field.
- Use solarization and biosolarization, described above in the Weeds section.

The following are some allium diseases.

Bacterial diseases of the bulbs cause bulb rot. Symptoms include discoloration of the foliage from yellow to brown and wilting of the plant, softening of the bulb, progression of symptoms from the neck to the base of the bulb, and the neck becoming soft when pressed. Cultural controls are the most common control methods. If the plants are damaged by hail or wind and there is a risk of wetting the necks, an application of copper fungicide is recommended.

Botrytis of the leaf is caused by spores falling on the leaf in the presence of moisture. These spores germinate and cause spots on the leaves. If there is humidity for periods of more than 20 hours with temperatures of 59°F to the mid-70s (°F), disease can develop (Turini et al., 2023). If cultural controls are not enough to reduce the incidence of disease, then it is advisable to monitor the crop and, if spots are observed on plants of five leaves or more, it is recommended to apply a fungicide with an adjuvant approved in organic production because alliums have waxy leaves. Biorational fungicides with the following active materials are used to control leaf botrytis: petroleum oil, mineral oil, neem oil, paraffinic oil, thyme oil, azadirachtin, sulfur, potassium bicarbonate, copper octanoate, copper sulfate, copper hydroxide, citric acid, copper sulfate pentahydrate, polyoxin D zinc salt, sodium carbonate peroxyhydrate, potassium salts of fatty acids, and microbial fungicides that contain the following: *Streptomyces lydicus, Streptomyces griseoviridis, Bacillus amyloliquefaciens, Trichoderma harzianum, Trichoderma viridi, Ulocladium oudemansii, Bacillus subtilis, Gliocladium catenulatum,* or *Reynoutria sachalinensis.*

Botrytis of the neck and ***bulb rot*** infect onions, garlic, leeks, and shallots. Symptoms appear in the field at the end of the season or during storage. The fungi persist in dead leaves and in the soil, where they release spores when conditions are favorable [persistent cold (50°F to 75°F) and humid weather] (Nischwitz, 2013). Apply cultural controls to avoid conditions that favor pathogens. Healthy crops, harvested at the right time and properly stored, are rarely affected. Chemical controls are the same used against leaf botrytis, but they are used one month before harvest if symptoms of the disease are observed.

Black mold is detected on the neck or skin of the bulb if it is covered with black spots, which are the spores where an injury or wound caused an opening in the skin. This is a postharvest problem and more common in warm areas. There are no fungicides for the direct control of this pathogen, and cultural practices help prevent the development of this disease.

Blue mold is caused by several species of *Pennicillium*. These fungi are common in plant residues and senescent plant tissue. Pathogens usually invade onion bulbs and garlic through wounds, bruises, or unhealed neck tissue. Mold appears during harvesting and storage and the best prevention is to cure the bulbs well, avoid damage or mishandling of bulbs, and store them in low relative humidity with maximum temperature of 41°F.

Purple blotch is caused by the fungus *Alternaria porri* that is characterized by forming water-soaked lesions in the foliage, decreasing the quality of the bulbs. The affectations occur in leaves, stalks, and bulbs, appearing on the foliage as white and sunken lesions with reddish-purple centers. Older leaves are the most affected; however, when plants are infested by thrips, younger leaves may be susceptible, and the severity of the disease is greater. Fungicides with potassium bicarbonate, copper oxide, or *Bacillus subtilis* may provide some control.

Downy mildew appears first on older leaves losing their green color and yellowing. Infected leaves produce a mass of gray spores that eventually wither and die. It does not kill the plant completely but disrupts the development of the bulb, affecting the quality and storage abilities. Cultural controls and microbial fungicides such as *Bacillus amyloliquefaciens, Bacillus subtilis,* and *Bacillus pumilis* are used in organic production.

Pink root is caused by the fungus *Phoma terrestris,* which infects the roots of numerous *Allium* species. Infected plants decrease their growth due to the progressive death of parasitized roots that develop a reddish color. Cultural controls and fungicides with potassium bicarbonate and Bacillus subtilis are used to control this disease.

Rust is caused by the fungus *Puccinia allii,* which infects alliums exclusively. Symptoms appear as white or yellowish spots on the leaves. These spots then become blisters or pustules that release spores, infecting other plants. Infected leaves turn yellow and then wilt, drying the plant and reducing yields. Cultural controls and the use of the microbial fungicides *Bacillus amyloliquefaciens* and *Bacillus subtilis* can reduce the incidence of this disease.

White rot is caused by the fungus *Stromatinia cepivora (Sclerotium cepivorum),* whose symptoms begin with the leaves yellowing and then wilting. Cottony white fungi with black dots appear at the base of the plant. The black dots that are called sclerotia spread this disease and can rest in the soil for as long as 30 years. Cultural controls, in particular biosolarization or solarization, are effective, as are copper fungicides and the microbials *Bacillus amyloliquefaciens* and *Bacillus subtilis.*

Viruses cause various diseases in alliums, such as garlic mosaic, onion yellow dwarf virus, iris yellow spot virus, and others. Symptoms appear, such as a mild to strong mosaic, chlorotic mottling, and leaf streaks. Infected plants are stunted. Once the plants are infected, they cannot be cured of the virus. Cultural controls include crop rotation and elimination of symptomatic plants and weeds that can serve as a reservoir for viruses. Controlling vectors such as aphids, thrips, and mites can reduce the spread of these diseases.

Nematodes are microscopic worms that inhabit the soil, which feed with a stylet (needle) by piercing and absorbing food from the roots and bulbs. They are difficult to detect and control, but in large numbers they can destroy the root system of allium crops, causing losses in yield and quality. Cultural practices such as rotation, solarization/biosolarization, and sesame oil-based nematicides can reduce populations.

Summary

Alliums are a diverse genus of plants that can be successfully produced organically. Producers must understand the requirements of allium production and storage. It's important to plan organically approved methods of controlling weeds and other pests, for organic allium crops.

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References

Adam, Katherine. 2006. Organic Allium Production. National Center for Appropriate Technology ATTRA publication.

Dawling, Pam. 2020. Market Gardening: Garlic planting. Growing for Market.com.

Lang, Kristine. 2023. Leeks: Harvest and Storage. South Dakota State University Extension.

Miyao, G, P.B. Goodell, R.M. Davis, K.J. Hembree, E.T. Natwick, A.T. Ploeg, B.J. Aegerter, W.T. Lanini, J.J. Stapleton, C.S. Stoddard, K.V. Subbarao, J.T. Trumble, and F.G. Zalom. 2016 (revised continuously). UC IPM Pest Management Guidelines: Tomato. UC ANR Publication 3470. Davis, CA.

Newenhouse, A.C. 2011. Growing Fresh Market Onions, Garlic and Leeks. UWEX Publication A3904-03

Nischwitz, Claudia. 2013. Botrytis Neck Rot of Onion. Utah State University/Utah Pest Extension.

Turini, T.A., S.K. Dara, J.O. Becker, R.F. Smith, C.L. Swett, B.J. Aegerter, R.M. Davis, S.A. Fennimore, E.T. Natwick, S.B. Orloff, A.I. Putman, B.B. Westerdahl, and R.G. Wilson. 2023 (revised continuously). UC IPM Pest Management Guidelines: Onion and Garlic. UC ANR Publication 3453. Davis, CA.

University of Massachusetts Extension Agriculture and Landscaping Program. 2012. Onions and Related Crops.

Further Resources

All the Alliums. Cattail Organics. cattailorganics.com/2022/04/13/all-the-alliums

Allium Growth Stages. Sustainable Market Farming. sustainablemarketfarming.com/wp-content/uploads/2023/01/Alliums-Year-Round.pdf

Garlic and Perennial Onion Growing Guide. Southern Exposure Seed Exchange. southernexposure.com/garlic-and-perennial-onion-growing-guide

Grow Odd Alliums. Maine Organic Farmers and Gardeners. mofga.org/resources/alliums/grow-odd-alliums

Organic Garlic Production. Michigan State University Extension. E3371. canr.msu.edu/resources/organic_garlic_production_e3371

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