

A Plain Language Guide

Growing Fresh Market Onions, Garlic, and Leeks



A. C. Newenhouse



The Wisconsin Farm Center has more information about services to help beginning farmers. To find this information on the internet look under the heading Farming and Agriculture at <http://datcp.state.wi.us/>.

Your local county Extension office also has more information for fresh market farmers. Go to <http://www.csrees.usda.gov/Extension/>. Click on your state and then your county to find the Extension office near you.



Index

| | |
|---------------------------------------------|-----------|
| Plant Description | 1 |
| Onions | 2 |
| Garlic | 4 |
| Elephant Garlic | 4 |
| Leeks | 5 |
| Chives | 5 |
| Wild leek or Ramp | 6 |
| Site Selection | 6 |
| Variety Selection..... | 7 |
| Planting and Care | 8 |
| Starting Seeds | 9 |
| Soil preparation | 10 |
| Raised Beds..... | 11 |
| Seeding in the field | 11 |
| Transplanting | 11 |
| Onion growth | 12 |
| Garlic growth | 12 |
| Elephant garlic growth | 14 |
| Leek growth | 14 |
| Wild leek or ramp growth | 15 |
| Soils and Nutrient Management | 16 |
| Soil pH | 16 |
| Fertilizer needs | 17 |
| Irrigation | 18 |
| Harvest, Handling, and Storage | 19 |
| Onions | 19 |
| Garlic | 20 |
| Elephant garlic | 21 |
| Leeks | 21 |
| Wild leek or ramps | 21 |
| Preventing Stress on Your Body | 22 |
| Weed Management | 23 |
| Pest and Disease Management..... | 25 |
| Botrytis leaf blight..... | 26 |
| Botrytis neck rot | 26 |
| Downy mildew | 26 |



| | |
|-------------------------------|-----------|
| Onion smut..... | 28 |
| Purple blotch | 29 |
| Soft rot | 29 |
| Insect Management..... | 30 |
| Aster leafhopper..... | 30 |
| Black cutworm | 32 |
| Onion maggot | 32 |
| Onion thrips | 33 |



Plant Description

Onions, garlic, and leek are good crops to grow for the farmers market because you can sell them at different stages of growth, their harvest dates are flexible, and you can store them. You can also make products such as garlic braids to add value to your crop. Onions and garlic are basic cooking ingredients and are healthy to eat. If you grow different types of onions such as sweet onions, fall green onions, and storage onions, you can harvest from early spring through late fall.

Plant Description

Onions, garlic, leeks, chives, and shallots are all members of the Allium or onion family. These plants are native to central Asia. The typical onion or garlic flavor comes from an enzyme that acts with sulfur in the soil and makes sulfur compounds in the plant. These sulfur compounds are anti-microbial and anti-fungal and give onions medicinal value. Eating raw onions helps thin the blood.

Onions, garlic, and leeks have been used in cooking for at least 4000 years in middle Asia, Egypt, and the Mediterranean. Drawings of onions have been found on tombs in Egypt from 2800 BC. Leeks are native to the eastern Mediterranean.

Most plants in the Allium family (alliums) are cool season biennials. Biennial plants produce leaves the first year and flowers the second year. They live only two years. Farmers grow alliums as annual vegetables without letting them produce flowers. Alliums have shallow fibrous roots that grow down from a plate at the base of the plant. Allium leaves are thick and fleshy. Leaves grow out from the base of the plant. Leaves can be shaped like a tube or be slightly flat.

Allium plants form bulbs. The scales that make bulbs are actually the thick part at the base of each leaf. Plants form bulbs when they have the right day length and temperature. When the plant has grown until the right day





length, then high temperature will make it start to form a bulb. Plants with more leaves at that time form a bigger bulb and produce higher yield. Plant early to get the most leaves and largest bulbs.

When temperatures fall below 50°F, stems get longer and flowering begins. Flowers have both male and female flower parts and are pollinated by insects. The flower is shaped like a ball or an “umbel” and is made up of many individual flowers together.



Onion flower - ball

Dr. Michael Havey, haveylab.hort.wisc.edu



Onion flower - umbel

© Smithsonian Institution - W.S. Justice

Onions

Onion varieties (*Allium cepa* var *cepa*) are either short day, intermediate, or long day depending on the number of hours of light they need to start forming bulbs. If you grow long-day

onions under short day conditions you will get leaves but not bulbs. If you grow short-day onions under long-day conditions you will get small bulbs that start to form early. Farmers in the upper Midwest usually grow long-day onions. Long-day onions need at least 14 hours of daylength before they start to form bulbs.

Short day onions such as Bermuda onions won't grow in areas at more than 30° latitude.

You can grow long day onions to eat fresh or to store and keep for a long time. Onions that are called “sweet” are usually grown to eat fresh. Onions that are called “dry” can usually be stored for a long time. Long-day onions usually have sharper flavor than short-day onions. Some factors change the sharpness of an onion's flavor. These factors are variety, temperature, soil pH, and soil moisture.

Onions can be round, slightly flat, or cone-shaped. Onion skin can be white, yellow, brown, red, or purple. Onion skin is used to dye cloth. If onions grow quickly in a short time their bulbs can become longer. If onions grow slowly over a long time their bulbs are larger. If side bulbs sprout from inside the base of several leaves then you will see many smaller bulbs form.

Green onions (*Allium cepa* var *cepa*) are immature onions that you harvest before the bulb forms.

Scallions or “bunching onions”

(*Allium cepa* var *cepa*) are varieties that will never form a bulb. Even if the conditions are right for other varieties to form a bulb, scallion varieties will not make a bulb.

**Green onions**

Japanese bunching onions (*Allium fistulosum*) do not form bulbs. They are similar to scallions. Japanese bunching onions are very hardy. You can plant them by seed in late summer and they will overwinter. Harvest them in spring.

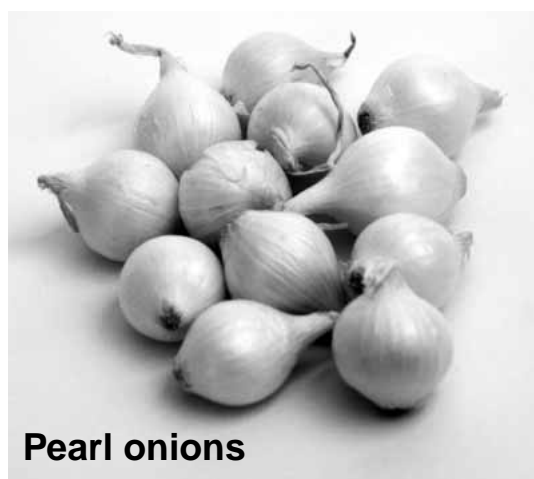
Multiplier onions (*Allium cepa* var *aggregatum*) form 4-5 bulbs inside each leaf sheath. The sheath is the part of the leaf that forms at the base of the leaf around the stem. Eat the green tops raw like green onions and use the bulbs in cooking.

Shallots (*Allium cepa* var.

ascalonicum) look like onions but they form a cluster of small bulbs instead of one single bulb. Shallots have a delicate flavor. Harvest shallots when they are about 2 inches across.

**Shallots**

Pearl onions are either true onions (*Allium cepa*) or a variety of *Allium ampeloprasum*. They are short-day plants grown under long day conditions close together in the row so that they form tiny bulbs. Pearl onions are often pickled.

**Pearl onions**



Summer mini onions or cipollini

(*Allium cepa*) are small, flat early onions planted in early spring. Harvest them after 60 days when they are 1 ½ - 2 inches across. Summer mini-onions are mild and sweet.



**Summer mini onions
or cipollini**

Garlic

Garlic (*Allium sativum* var *sativum*) is a cool season perennial plant made up of many cloves. Each clove has one papery leaf and a second, thick storage leaf that forms the clove. Plants can produce 4-40 cloves at the base of a stalk. Garlic leaves are long, flat and folded. The flower stem of a garlic plant is called a scape. Small



Garlic

bulbs (bulbils) can form at the top of the flower stem.

There are two kinds of garlic varieties: hardneck and softneck. Hardneck garlic is more cold hardy and has a milder flavor than softneck. Hardneck garlic makes a flower stalk. This flower stalk dries to form a stiff “neck” for the garlic. Most farmers in the Midwest grow hardneck garlic. Some softneck varieties also grow well in the Midwest. Softneck garlic stores better than hardneck. You can braid the stems of softneck garlic to hang it for drying. Some softneck garlic varieties will form a flower stalk if they grow in the right conditions.

Elephant Garlic

Elephant garlic (*Allium ampeloprasum* var. *holmense*) is a form of leek that grows into a bulb that looks like garlic. Elephant garlic has a mild flavor.



Leeks

Leeks (*Allium ampeloprasum* var. *porrum*) are very hardy biennial plants that grow long, thick white stems. The leaves are solid, flat, and folded like garlic leaves. Leeks do not grow into bulbs. Leaves grow from the base of the plant. They form opposite each other on the stem. New leaves grow above the old. Leeks are sweeter than onions. Cooked leeks have creamy texture. Use leeks to flavor soup and stew.



Leeks

Chives

Chives (*Allium schoenoprasum*) are perennial plants that grow in a mound as an herb. Chive leaves are used in cooking. They have mild flavor. The chive plant does not form large bulbs. Chives flower every year.



Chives



Wild leek or Ramp

Wild leeks, or ramps, (*Allium tricoccum*) are native perennial plants that you can find in the woods of the Midwest. They grow in the moist forest floor of northern US and Canada as far west as Minnesota. Ramps have two-three leaves 6-18 inches tall. Ramp leaves look like lily leaves. Ramp leaves smell like onion or leek. Bulbs smell like mild, sweet garlic. Flowers are white to creamy yellow and bloom from June to July after the leaves start to die. Native Americans used ramps in cooking. Many chefs like the sweet flavor of ramps.



Wild leek or Ramp

Site Selection

Onions and their relatives are called alliums. They grow best in full sun. Alliums like well drained soil with high organic matter; (at least 20%). This type of soil is sometimes called 'muck' soil. Alliums also grow well on sandy soils if they are watered. Alliums do not grow well on heavy clay soils. They also cannot grow in soil that stays wet. Alliums have shallow roots and plants dry out quickly. If you do not have irrigation for your alliums, choose soil that is well drained and holds moisture.

Soil pH should be 6.0-6.8. Do not plant onions or their relatives right after beets or cole crops (broccoli, cabbage, etc.) in the same field because those crops lower the pH too much for onions.

One season before you plant alliums, plant cover crops in the field. Work them into the soil to add organic matter. These types of crops are sometimes called "green manure crops". Cover crops such as buckwheat, rye, and mustards work well as green manure for the soil. Remove weeds and rocks from the field as much as you can before planting onions and their relatives.

Grow leeks on deep soil so that you can cover them to whiten the stalks.



Variety Selection

Variety Selection

Choose varieties of onions and their relatives that suit market gardening in the Midwest. Look for varieties that resist disease, tolerate heat, have good flavor, store well, and are ready to harvest early. When you choose garlic and leek varieties, also look for ones that are winter hardy. If you try a new variety, plant it next to the variety that you normally grow so you can compare the two. Table A lists some varieties that usually grow well in the upper Midwest.



| Table A. Onion, Garlic, and Leek Varieties | |
|--------------------------------------------|--------------------------|
| | Variety |
| Onion | |
| <i>White</i> | Evergreen White Bunching |
| | Super Star (Spanish) |
| | Sweet Spanish |
| | Walla Walla (sweet) |
| <i>Yellow</i> | Candy (sweet) |
| | Copra (storage) |
| | First edition (storage) |
| | Yellow Sweet Spanish |
| <i>Red</i> | Mars (storage) |
| | Mercury (storage) |
| Garlic | |
| <i>Softneck</i> | California White |
| | Inchelium Red |
| | New York White |
| | Polish White |
| <i>Hardneck</i> | Chesnok Red |
| | German Extra Hardy |
| | Killarney Red |
| | Music |
| | Russian Red |
| | Siberian |
| | Spanish Roja |
| Leek | |
| | American Flag |
| | Giant Musselburg |
| | King Richard |
| | Otina |
| | Pancho |



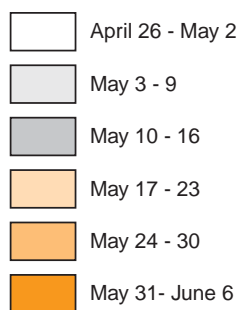
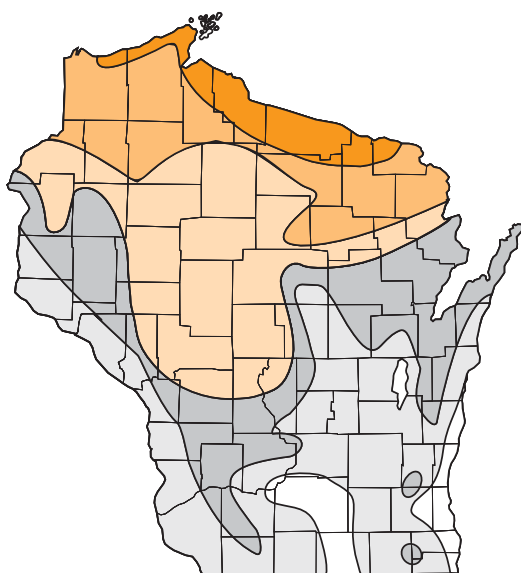
Planting and Care

You can grow onions from seed, “sets”, or transplants. Since most onions need a long growing season, most farmers usually plant transplants instead of planting onion seeds in the field. You can start your own seedlings or buy them

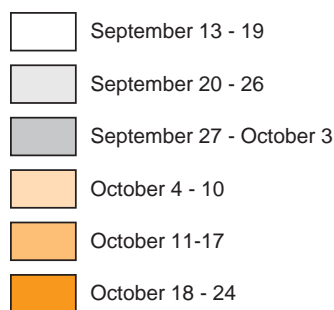
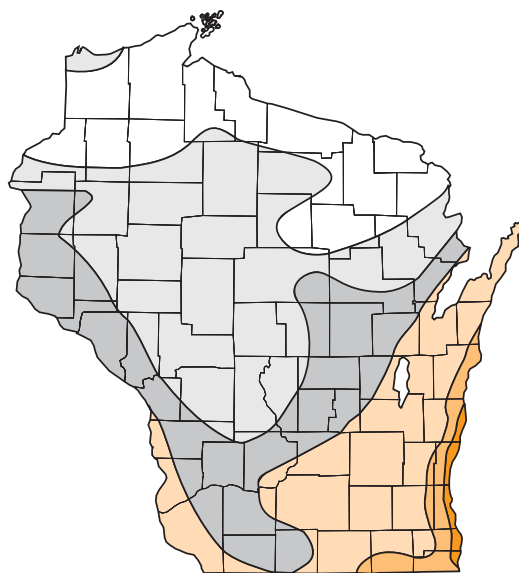
from a dealer. Do not grow onions from “sets” if you plan to sell onions at the market. Sets are the second year’s growth of storage or multiplier onion varieties. Onions grown from sets are not as sweet as the onions you grow from transplants. Also, sets can go to seed (“bolt”) early.

Frost dates maps

Last spring killing frost



First fall killing frost





Starting Seeds

Plant onion seeds in a greenhouse or under lights indoors 10-12 weeks before the last frost date in your area. Usually in the upper Midwest this occurs in late January or February. If you start onions indoors under fluorescent lights, give them at least 10 hours of light a day.

You can buy or mix your own sterile potting mix. The mix should include compost, peat, or sphagnum to hold moisture; vermiculite or perlite for aeration; and mineral and nutrient sources to feed the new plants after the first roots form. Add water to make the mix moist before you fill the transplanting trays.

Farmers plant onion seeds indoors into either cell packs or trays. It is a good idea to sterilize transplant trays in a 10% bleach solution before you plant. This will prevent bacteria and fungi from infecting the young seedlings.



- ❖ Fill the plastic or styrofoam cell trays with potting soil, or make individual blocks with a soil blocker. Cells or soil blocks as small as $\frac{3}{4}$ inch diameter are fine.
- ❖ Plant seeds $\frac{1}{4}$ inch deep. Either plant them in rows in trays or plant 2-5 seeds per cell or soil block.
- ❖ Label the trays with variety and planting date.
- ❖ Keep soil moist but not wet.
- ❖ Use a heating mat or cable under the trays to keep the soil warm to 70-72°F until the seedlings sprout. You should see seedlings sprouting in 6-12 days.
- ❖ The temperature in the greenhouse should be 60-65°F during the day.
- ❖ The temperature in the greenhouse should be 55-60°F during the night.
- ❖ As leaves grow, clip them down to 3-4 inches to help them grow sturdy plants.
- ❖ At transplanting, the seedlings should be $\frac{1}{4}$ inch in diameter.
- ❖ One week before transplanting out to the field, harden off the plants by putting them outside for a few hours each day during the warmest time of the day, or move plants into a cold frame. The section on season extension describes a cold frame.
- ❖ Give the plants less water and no fertilizer while they are hardening off.



Table B gives the amount of seed you will need, how deep to plant seed, how far apart to plant, when to plant, days to first harvest, and yield.

Soil preparation

Alliums have shallow root systems and grow best in soil that is loose, crumbly, and does not contain stones or clods. If your soil has little organic matter, add compost. See the previous section on green manure crops you can grow to build the organic matter in your soil.

It is important to control weeds before you plant. You can use these methods:

- ❖ Pull weeds by hand.
- ❖ Smother weeds with a cover crop (such as buckwheat).

- ❖ Cover the soil with black plastic to heat it and keep out light.
- ❖ Use weed killer sprays (herbicide sprays).

For more information on weed control read the section on weed management on page 23.

Work beds 7-8 inches deep to promote good rooting. If leaves, stems or other organic matter from plants lie on the soil surface they might attract the onion maggot. Bury organic matter to reduce the onion maggot population. Never work wet soil because this can cause soil compaction. Compacted soils are hard and do not get enough air. Compacted soils prevent oxygen and water from reaching roots, and plants do not grow as well or produce as much.

Table B. Planting Guide

| Vegetable | Planting time in southern WI ^a | | Plants or seeds needed for 100 ft of row | Seed depth (inches) | Spacing (inches) ^b | | Days to first harvest ^c | Estimated yield (lb/ft of row) ^d |
|-----------|-------------------------------------------|----------|------------------------------------------|---------------------|-------------------------------|----------------|------------------------------------|---------------------------------------------|
| | Indoors | Outdoors | | | Between rows | Between plants | | |
| Onion | Feb. 15 | 15-Apr | ½ oz | ¼- ¾ | 16-24 | 3-4 | 110-120 | 200 lb |
| Garlic | - | Oct.15 | 400-600 cloves | 2-3 | 18-30 | 4-6 | 60-90 | 40-70 lb |
| Leek | Feb. 15 | 15-Apr | ¼- ½ oz | ¼- ¾ | 16-24 | 4-6 | 120-150 | 150 stalks |

^a Plant about 1 week later along the lower lake shore and about 2 weeks later in the north.

^b If you use a plate-type seeder, the plate will make the spacing between plants.

^c Varieties are ready to harvest at different times; plant different types to have a longer growing season.

^d Estimated yields under less than ideal growing conditions; actual yields will vary widely with weather, soil fertility and cultural practices.



Raised Beds

You can use raised beds to improve soil drainage and prevent compaction. Raised beds are usually 4-5 feet wide and 100 feet long. Leave a 1-foot aisle on either side of each bed for a path.

Seeding in the field

Some farmers do not plant transplants but seed directly into the field. If you plant seeds in the field you will need to thin the plants. Some companies sell pelleted seeds that are coated and rolled to make them uniform and easier to handle, especially for growers who plant with a precision seeder. Precision seeding is done with special planters and uniformly sized seeds, and is done in a way that you do not have to go back and thin the plants. Many different types of planters are available such as the gravity-feed cone seeder, belt-drive seeder, vacuum seeder, and walk-behind plate-type seeder. If you are an organic grower, check to make sure that the coating on pelleted seed is organic, because some pelleted seeds have pesticides in the coating.

- ❖ Plant seeds $\frac{1}{4}$ - $\frac{3}{4}$ inches deep,
- ❖ 8-12 seeds per row foot.
- ❖ Thin onions to 3-4 inches between plants and leeks to 4-6 inches.

In good conditions, seeds sprout 6-12 days after planting. The best temperature for allium seed sprouting is between 70-85°F.

You can also seed onions in the field to raise transplants for planting later.

To raise transplants in the field, plant seeds closer together; at about 30 seeds per row foot. When plants are $\frac{1}{4}$ inch in diameter dig them up and transplant them.

Transplanting

Transplant onions in mid-April, after frost is out of the ground and about 4 weeks before the last date that frost usually occurs. You can use transplants that you grow yourself or you can buy transplants. If you buy them, soak the roots right away in a shallow pan of water and plant them within a day or two. If you grow your own transplants they will be ready to go out into the field when they are $\frac{1}{4}$ inch in diameter.





At transplanting, clip off tops to 5 inches so the plants do not dry out as much while the root system grows. Plant transplants 1 inch deep and 4 inches apart. Water transplants immediately.

Onion growth

Each onion variety needs a certain day length to start forming a bulb. Until the plant gets the critical amount of day length, it will grow new leaves but not form a bulb. You can harvest and sell onions before they form a bulb. These are called “green bunching onions”.

After an onion starts to form a bulb, many factors affect its growth rate and size. These factors are temperature, fertilizer, soil moisture, and having enough space and light.

When a plant forms an early flower and seed stalk it is called “bolting”.



Gerald Holmes, Valent USA Corporation,
1571140 Bugwood.org

Onions and other alliums bolt when the temperature is between 40-50°F for 1-2 months. Onions grown from sets bolt if the temperature in spring stays cool for a long time.

Garlic growth

Plant garlic from cloves. At harvest, you can save cloves to plant for next year. Big cloves grow into big bulbs. The flower stem of a garlic plant is called a scape. Tiny bulbs called bulbils form at the top of the scape. These bulbils will grow into garlic bulbs but they will be too small to sell.

The best time to plant garlic bulbs is in the fall, 6-8 weeks before the ground freezes. This gives garlic cloves enough time to grow strong roots before winter. Do not plant garlic in the spring. Warm spring temperature and longer day length in spring will cause garlic cloves to form a bulb too early.

In fall, plant cloves 4 inches apart in the bed. 100 lbs of garlic will plant 1000 ft². Divide the bulbs into cloves just before planting. If you divide the bulbs earlier, disease can infect the cloves more easily. Plant cloves with their points up. Plant garlic cloves 2-3 inches deep and 4-6 inches apart.

Farmers usually plant garlic in double or triple rows in beds that are 2-3 feet apart. If you plant garlic cloves too shallow, shoots will start to grow in the fall. These tender shoots will be killed in the winter and roots will not grow as strong.



Planting and Care

After the soil freezes, put a mulch of straw 4-6 inches thick over the plants. This will keep the soil frozen during the winter and prevent the soil from heaving up and cracking. Heaving soil tears and dries roots.

In early spring, rake off the straw mulch to help warm up the soil and speed growth. Some farmers leave the straw mulch in place to add organic matter to the soil.

Garlic needs nitrogen for best growth. If your soil has more than 20% organic matter, add 35 lbs nitrogen per acre during the growing season. On sandy soils with less than 2% organic matter, add 60 lbs nitrogen per acre during the growing season.

Divide the total amount of nitrogen you need and add a little at a time so the plant can take it up. If you plan to add nitrogen twice, add half at planting time and add the other half in spring about 2 weeks after you see sprouts grow. If you plan to add

nitrogen three times, add one third at planting, one third in spring 2 weeks after sprouts grow, and one third a month later.

Garlic needs time to slow its growth and die back before harvest. Do not add nitrogen in the last 60 days before harvest.

In early summer when the scape on hardneck garlic has formed a circle, remove it and its bulbils. This will help the bulb grow larger with 8-10 cloves. You can sell the fresh garlic scapes (with or without bulbils) at market. They have a mild garlic flavor.

You can also sell green garlic, which is garlic that is harvested before it forms bulbs. You can harvest green garlic from small cloves, dense plantings, or plants that you have thinned from the field. Green garlic has a milder flavor than bulb garlic. It can be eaten raw or cooked.





Elephant garlic growth

Elephant garlic is a little less hardy than regular garlic. Plant elephant garlic the same way as regular garlic except for these differences:

- ❖ Plant elephant garlic cloves 2-3 inches deep and 6-8 inches apart.
- ❖ In spring, break off any flower buds.
- ❖ Give elephant garlic about three times more nitrogen than regular garlic.

Leek growth

Leeks tolerate colder temperatures than onions and garlic. Leeks grow best between 68°F and 78°F. They grow in soils similar to onions and garlic, but they like wetter conditions.

Farmers usually start leek seeds indoors and then transplant them into the field. Leek seeds take a long time to sprout. Plant leek seeds in flats $\frac{1}{4}$ inch apart and $\frac{1}{4}$ inch deep. Plant seeds in February and March. When the plants are big enough to handle, transplant them into another flat and put them 1 inch apart. Then in mid to late April, plant the leeks into the field.

Plant leeks 4-6 inches apart in the row and 18 inches apart between the rows. When you plant leeks into the field, dig a furrow or holes 5-6 inches deep. Leave at least 1-2 inches of leaves above the soil surface. Leave the soil loose around the base of the stem.

Leeks are sold “blanched”, or with white stems. The longer the white stem, the higher the quality of leek. To get leeks with white stems you must cover the base of the plant with soil as it grows. Wait until the leeks put out new strong growth. Then start gradually filling in the furrow with soil higher up the stem. Do not bury the place where the leaf grows from the stem. You can use a cultivator or hoe to hill soil up the stem. Do this two or three times during the growing season as the leeks grow. At the end of the season, 5-6 inches of the stem will be white.

Leeks grow slowly. It can take 120-150 days for leeks to mature.



Leeks



Wild leek or ramp growth

You can collect wild leek or ramps from the wild if you follow these rules:

- ❖ Ask the landowner for permission to collect the plants.
- ❖ Do not collect plants on public land; it is prohibited.
- ❖ In each patch you find, collect only a small amount and leave the rest.
- ❖ Collect no more than 5-10% and leave the rest. That means if you see a patch with 20 plants, harvest no more than 2 plants.
- ❖ The rest of the plants will grow and keep the population healthy.

You can grow your own wild leek or ramps. Choose a shady, moist location that is well drained. The soil should have a lot of organic matter. The shade could be from trees or from a shade structure that you build in the field.

Wild leek or ramps are perennial plants that grow new leaves every spring, from March-April. In June, the leaves die and the plant grows a flower stalk. The flower blooms in early summer. Seeds form in late summer. Seeds will stay dormant until they get a warm moist period and then a cold period. After that they will break dormancy and sprout.

You can grow wild leek or ramps from seed.

- ❖ Plant wild leek or ramps seeds in the fall. If the seeds did not get a warm moist period and then a cold period, then it can take 18 months for them to sprout.
- ❖ Plant enough seed so that you have 5-7 times more wild leek or ramps than you need to harvest.
- ❖ After planting, cover seeds with 2-3 inches of leaf mulch.
- ❖ Each year, harvest only 1/7 - 1/5 of the plot. The rest of the plants will grow and keep the population healthy.
- ❖ If you grow wild leek or ramps from seed it will take 5-7 years until the plot is mature.

You can also grow wild leek or ramps from transplants or bulbs.

For transplants:

- ❖ Plant transplants in March-April.
- ❖ Plant transplants to the same depth they were growing.
- ❖ Cover with 2-3 inches of leaf mulch.

For bulbs:

- ❖ Plant bulbs in March.
- ❖ Plant bulbs 4-6 inches apart and 3 inches deep.
- ❖ Leave the tip of the bulb above the soil surface.
- ❖ Cover with 2-3 inches of leaf mulch.



Soils and Nutrient Management

Get a soil test before you plant a field for the first time and then at least once every 3 years. For information on how to collect samples and where to send them for analysis, see University of Wisconsin Extension publication *Sampling Soils for Testing* (A2100).

Most soil tests include pH, organic matter, phosphorus, and potassium. You can also ask to test for nitrate-nitrogen, calcium, magnesium, sulfur, boron, manganese, and zinc. You will receive the results of your soil test along with fertilizer recommendations based on how you will use your field. You can also test your potting soil that you use to grow transplants.

Compared to other vegetables, onions and other alliums need a lot of fertilizer and have shallow roots.

When you add fertilizer to these crops, put it in a strip alongside the plants, do not cover the planting bed. This is because the roots don't grow

far away from the plant. Give onions and other alliums nitrogen in 2-3 small amounts during the growing season instead of one large amount at one time.

Soil pH

Soil pH measures acidity and should be at the correct level so the crop can take up enough nutrients and minerals from the soil. Plants that don't have enough nutrients and minerals can turn yellow. Onions and other alliums that don't have enough minerals can have leaves that grow poorly, grow twisted, and have other problems.

- ❖ For onions grown on most types of soil, the pH should be 6.5-8.0.
- ❖ For onions grown on peat soil, the pH should be 5.8.
- ❖ For garlic, the soil pH should be 6.0-7.0.
- ❖ For leeks, the soil pH should be 6.0-8.0.
- ❖ If the pH is below 6.0, apply aglime to raise the pH.



Fertilizer needs

Onions and other alliums need nitrogen, phosphorus, and potassium in large amounts and many other nutrients in small amounts.

Compared to other vegetables, onions and other alliums need more phosphorus and potassium. They also need more copper, manganese, zinc, and molybdenum. Check your soil test results to see how much of these nutrients you need to add. Onions and other alliums have a shallow root system, so they need small amounts of fertilizer often. Table C gives the amount of fertilizer these plants need.

Choose fertilizer from organic or inorganic sources. Healthy soil has tiny organisms (microbes) that break down organic matter into nutrients that plants need to grow. Over time, organic fertilizer can build your soil and make the soil more healthy and fluffy which lets plants grow more

easily. Inorganic fertilizers give plants nutrients quickly but do not build the soil. Some inorganic fertilizers have a lot of salt which is bad for soil organisms.

Organic fertilizers can come from manure, compost, fish meal, bone meal, and live compost tea that includes oxygen. Recent studies show that live compost tea helps prevent plant diseases and also gives nutrients to plants.

Live compost tea is made by carefully mixing fungi, bacteria, sugars, water, and a steady stream of air to grow active soil micro organisms.

If onions and other alliums do not get enough manganese, the plants grow slowly and leaves turn light green and curl. The neck of the plant becomes thicker but the plant is slow to form a bulb. Some plants that do not get enough manganese gradually

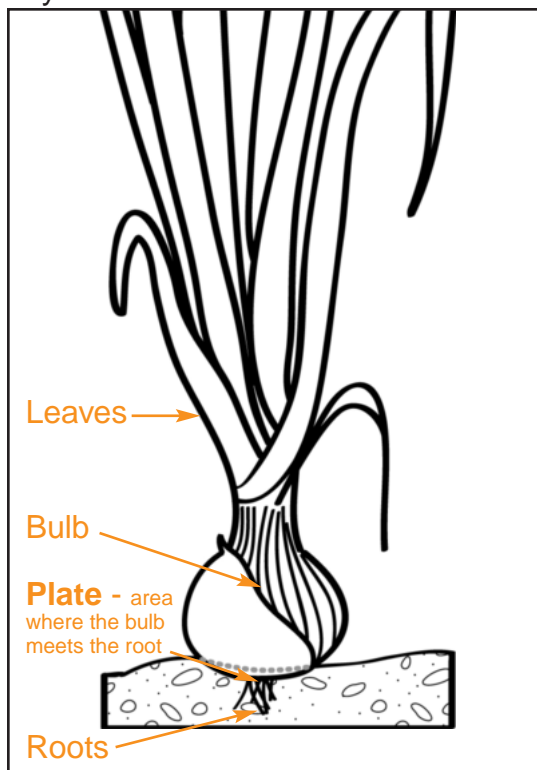
| Table C. - Soils and nutrients | | | | | | | | |
|--------------------------------------------------|----------------|------------------------------|--------------|----------------------|--------------------------------------------|--------------|---------------------------|--------------|
| Annual nitrogen, phosphate, and potash for onion | | | | | | | | |
| | Nitrogen | | | Phosphate and potash | | | | |
| | Organic matter | Amount to apply ^a | | | Amount to apply ^a | | | |
| | | | | Yield | Phosphate (P ₂ O ₅) | | Potash (K ₂ O) | |
| Vegetable | % | lb/a | oz/100 sq ft | Cwt | lb/a | oz/100 sq ft | lb/a | oz/100 sq ft |
| Onions | <2.0 | 150 | 5.5 | 400-600 | 60 | 2.2 | 130 | 4.78 |
| | 2.0-9.9 | 140 | 5.25 | | | | | |
| | 10.0-20.0 | 130 | 4.78 | | | | | |
| | >20.0 | 120 | 4.5 | | | | | |

become olive green and look wilted. Muck type of soils with a high pH are the type of soils that would most commonly have too little manganese.

If onions and other alliums do not get enough zinc the plants grow slowly and leaves start to twist and bend like a corkscrew. Younger leaves start to turn yellow between the leaf veins and yellow stripes form up and down the leaves.

Irrigation

Onions need water regularly because they have a small shallow root system. Keep the top 3-4 inches of soil moist. Roots grow from a flat “stem plate” on the bottom of the bulb. Until the onion forms bulbs, this stem plate should not dry out. On sandy soil you might need to water every day.



After the plants start to form a bulb, give them an inch of water a week. Soak the ground once a week so the plants form a strong root system. It is better to water heavily once a week than to water lightly several times a week. Stop watering plants 1-2 weeks before harvest.

Garlic needs even soil moisture when it is forming a bulb (April-June). Stop watering plants 3-4 weeks before harvest (mid July-mid August) so the bulbs do not rot.

Leeks need less water than onions. After they begin to grow, they will only need to be watered if there is a long drought.

As plants grow, notice if leaves wilt in the middle of the day. If so, they need water. If plants wilt a few times, they will produce a smaller yield. Plants that wilt often or for a long time might die.

Use either drip irrigation or sprinkler. Drip irrigation saves water and helps prevent leaf diseases. Mulch can help keep moisture in the soil.





Harvest, Handling, and Storage

Onions

Harvest fresh onions when 15-25% of the tops have fallen over. Harvest storage onions when 50-80% of the tops have fallen over. If you harvest storage onions earlier, they might rot during storage. If you harvest onions later (after more than 80% of the tops have fallen over) they might get diseases more easily in the field.

Harvest onions by cutting under the roots and lifting the bulbs. You can do this with a tractor and a digger similar to a potato digger or you can do this by hand with a spade or spading fork.

For green onions, harvest them when the tops are at least 6 inches tall and ½-1 inches in diameter. Two to three weeks before harvest, cover the base of the stems with about 2 inches of soil to “blanch” them and keep them white.

At harvest, pull off the brown outer skin and trim the leaves. Make bunches according to the size commonly sold at your market. Most bunches have 5-7 onions. Use a rubber band to hold the bunch together. If you wear many rubber bands around your wrist you can make bunches quickly. After harvest, keep green onions cool.

Storage onions need to be cured and dried. Afterwards, they will go dormant and last longer. Storage

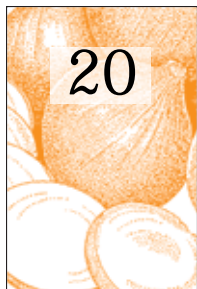
onions that have been cured are less likely to become infected with diseases. Low humidity and temperatures of 85-90°F are best for curing. Leave the dry outer scales on the bulbs while you cure the onions.

There are many ways to cure and dry onions. If you cure onions outside, protect them from moisture and direct sun. Put onions in the shade in a place that will not get rain or heavy dew. Dry days with a good breeze will help cure and dry the onions. You can put onions on screens to help dry them.

Onions with dry outer scales and a dry neck have been cured correctly. They can be stored for up to 6 months at 32°F and humidity levels of 60-70%. If the temperature in storage is higher than 40°F, the onions might sprout.



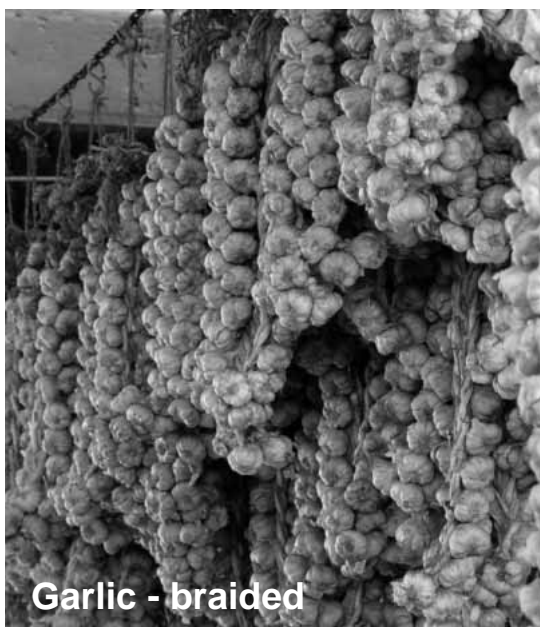
Troy Community Farm, Madison WI



Garlic

Harvest garlic when $\frac{2}{3}$ of the tops are dry and the leaves collapse. Pull a few bulbs when you think the plants might be ready to harvest and look at them to help you decide when to harvest the crop. If you harvest too early the garlic bulbs will be small. If you harvest too late, the skin might split and lower the quality. If you leave garlic bulbs in the field too long, the bulbs can rot and cloves can start to split off the bulbs.

Harvest garlic on a warm, dry day so soil falls off the bulbs. The garlic will be easier to clean. Harvest garlic by cutting under the roots and lifting the bulbs. You can do this with a tractor and a digger similar to a potato digger or you can do this by hand with a spade or spading fork. Never pull garlic bulbs without first loosening the soil. Clean some of the soil off the bulbs.



Garlic - braided

If you plan to make and sell garlic braids, leave the tops on. Braid them as soon as you can after harvest. Then cure and dry the garlic braids the same way you cure and dry garlic bulbs. There are many ways to cure and dry garlic.

- ❖ You can harvest the garlic bulbs and leave them in long rows to dry in the field for a few days. After that, put garlic bulbs in plastic crates with good air flow and leave the crates in the field.
- ❖ You can put garlic bulbs in the shade in a place that has good air flow and where the bulbs will not get rain or heavy dew.

Cure and dry garlic for 30 days after harvest. The bulbs will lose up to half their weight. Flavor will improve.

After curing and drying, prepare garlic for storage.

- ❖ Peel off the outer one or two layers of skin.
- ❖ Trim roots to 1 inch.
- ❖ You can store garlic as is or with the dry tops removed, trimmed, or braided.
- ❖ If you trim the tops, leave them 1½ - 2 inches long.

Store garlic at 32°F and in 60-70% humidity. It will keep up to 6 months. If the storage temperature is higher than 40°F, garlic cloves will sprout. If humidity is higher than 70%, roots will start to grow and mold might grow.



Elephant garlic

Elephant garlic bulbs are ready to harvest when all the leaves start to yellow and the top is not yet dried. Elephant garlic bulbs are fragile. They bruise easily. The thin papery outer layer separates easily. When you harvest elephant garlic, carefully brush soil away from the bulbs. Do not knock the bulbs together. After harvest, trim the leaves and cut off roots. Dry and cure the bulbs for about 6 weeks. Often, elephant garlic is sold by the bagful in small net bags.

Leeks

Harvest leeks when they are still growing. They should be 1¼-3 inches thick, depending on the variety. You can keep leeks growing later in the fall if you mulch them with a thick layer of mulch such as straw. This will keep the ground from freezing. To harvest, dig under the leeks and cut the roots. Then pull out the plants. After harvest, trim roots and green leaves. Wash leeks lightly or wipe them clean. You can harvest and sell the immature greens and stems of leeks all during the growing season. Store leeks at 32°F and 95% humidity. Leeks will keep for 2 months.

Wild leek or ramps

Harvest ramps when the leaves are 12-18 inches tall. Be careful not to damage the bulbs. Keep them cool and moist when digging. After harvest, trim the roots and wash the bulbs. Pack them in waxed cardboard boxes and store them in a cooler.



Preventing Stress on Your Body

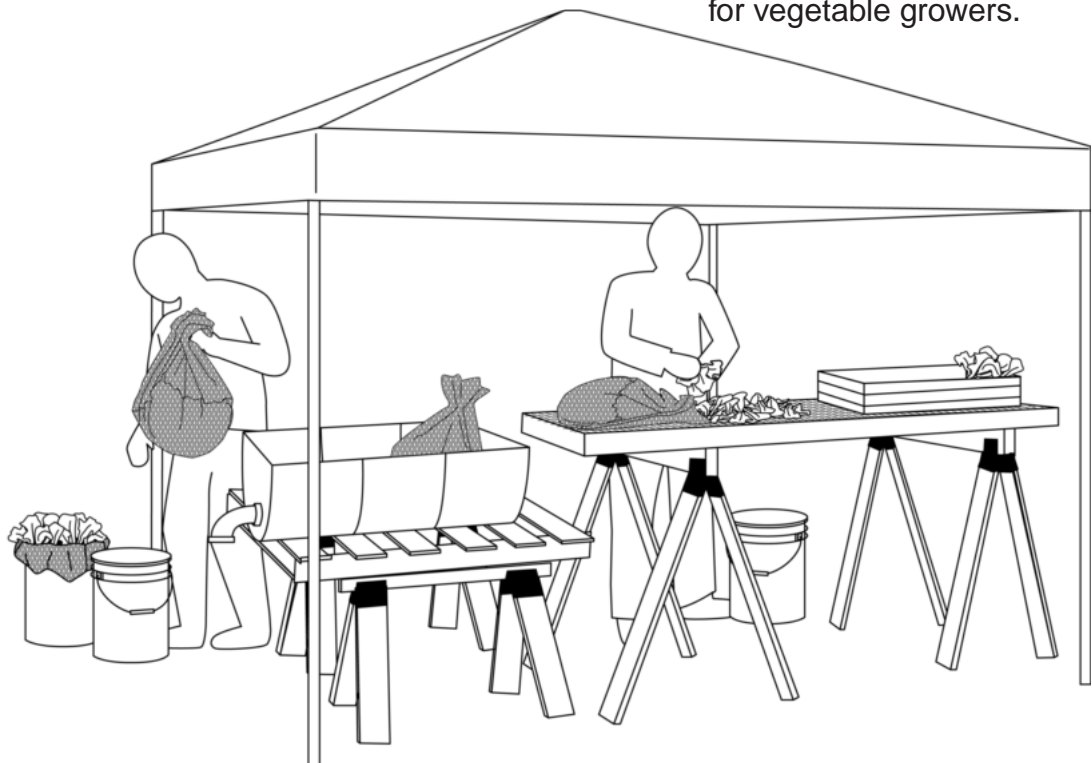
Try to prevent stress on your body when you grow leafy greens.

- ❖ Try to prevent stooping or bending.
- ❖ Change your position often.
- ❖ Sit on a stool or a pail. You can use a stool that you wear as a belt, or a stool on wheels that rolls along the row like a cart.
- ❖ Use garden carts and wagons as often as you can so you do not lift and carry so much.
- ❖ If you use a standard plastic container that stacks and is easy to load, unload, and clean, you will save time.

In the place where you pack your crops, try to have a smooth level floor so it is easier to work with carts and wagons.

- ❖ Set up your wash and pack area so you walk, carry, stoop, and bend as little as possible.
- ❖ Set up work areas the same height as a table.
- ❖ Short people might want to stand on a stool to reach the tables more comfortably.
- ❖ To move boxes of produce, there are systems you can use with small pallets and hand pallet trucks.
- ❖ You can also buy roller table to move heavy boxes of produce.

There are examples of tools that make work easier from the University of Wisconsin-Madison Department of Biological Systems Engineering. Go to the department website (<http://bse.wisc.edu/>) and look under 'Department Links' for the Healthy Farmers, Healthy Profits Project. Click on Tip Sheets and go to the category for vegetable growers.





Weed Management

You must control weeds to grow a good crop of onions, garlic, or leeks. Weeds take water, nutrients, space, and light away from your crop. Also, weeds left in the field might have diseases or insects that can harm your crop. Since the leaves on onions, garlic, and leeks do not grow to shade the ground, weeds are more of a problem on these crops. Be sure to watch your field for weeds and remove them as soon as you can.

Perennial weeds come up every year. Annual weeds start by seed and live one year. Biannual weeds grow from seed one year and flower the next year. Biannual weeds live only two years.

Before you plant, remove weeds. You can use these methods:

- ❖ Pull weeds by hand.
- ❖ Smother weeds with a cover crop (such as buckwheat).
- ❖ Cover the soil with black plastic to heat it and keep out light.
- ❖ Use weed killer sprays (herbicide sprays).

During the growing season, remove perennial and annual weeds.

- ❖ Cultivate or hoe regularly to remove annual weeds.
- ❖ If you cultivate early in the season you prevent most weed problems.
- ❖ If you use weed killers (herbicides), check and follow the rules on the label.
- ❖ Certified organic growers can only use approved organic weed killers.





Mulch helps keep weeds down and also helps prevent diseases and keeps the soil moist. You can use black plastic mulch to prevent weeds. Black plastic also helps warm the soil in the spring.

You can also use straw as a mulch. A thick layer of straw blocks sunlight from reaching the soil. Weed seeds won't sprout.

If you use chemical weed killers, be sure you check the label and understand that the one you choose is legal for the crops you sell. Chemicals legal for a home garden might not be legal if you sell the crops.

If you use chemical weed killers, be sure the one you choose is meant for the weeds found on your soil type. The weeds that typically grow on muck soils are different than the weeds that typically grow on other soils.





Pest and Disease Management

Onion diseases

The common diseases that attack onions, garlic, and leeks are botrytis, downy mildew, onion smut, purple blotch, and soft rot. All of these diseases except soft rot are caused by different fungi. Soft rot is caused by a bacteria.

Use these techniques to prevent fungus diseases in onions, garlic, and leeks:

- ❖ Plant resistant varieties.
- ❖ Plant disease-free seed.
- ❖ Do not plant in poorly drained soil.
- ❖ Wait 2-4 years before you plant onions, garlic, or leeks in the same field.
- ❖ Keep the field clean of weeds.
- ❖ Destroy old plants, stems and leaves.
- ❖ Remove old onions, garlic, or leeks from the fields.
- ❖ Use drip irrigation instead of sprinkler.
- ❖ Give plants enough fertilizer and water.
- ❖ Harvest when the bulbs are mature.
- ❖ Prevent cuts and wounds on the bulbs.
- ❖ Dry bulbs well.
- ❖ Store bulbs at the right temperature and humidity.
- ❖ Wash equipment after you use it.

Botrytis leaf blight

Description: A fungus invades the leaves. You see tiny oval whitish or yellowish spots on the leaves. If you cut the leaves you will see the spots through the thickness of the leaf.

Disease cycle: Over winter, the fungus lives in soil or on parts of onion plants left in the field. Spores blow in the wind on to leaves or are splashed onto leaves with rain or irrigation. If the plant has a cut or wound the spores enter the plant.

Management: Use the prevention techniques listed above.



Botrytis leaf blight

Howard F. Schwartz, Colorado State University,
5365841 Bugwood.org



Botrytis neck rot

Description: A fungus invades the neck but you don't see it until after the bulbs are harvested and stored. Soft areas start to form around the neck and toward the base of the bulb. The soft areas look sunken, brown, and water soaked.

Disease cycle: Over winter, the fungus lives in soil or on parts of onion plants left in the field. Spores blow in the wind on to leaves or are splashed on to leaves with rain or irrigation. If the plant has a cut or wound the spores enter the plant.

Management: Use the prevention techniques listed above and be sure the bulbs are dry before storage. Cut tops no longer than ½ inch at harvest.



Botrytis neck rot

Howard F. Schwartz, Colorado State University,
5364053 Bugwood.org

Downy mildew

Description: A fungus invades and kills the leaves. The plant forms smaller bulbs that do not mature. Leaves on plants with downy mildew have areas that are soft, pale green, oval, and look sunken. The tip of the leaf can flop over. With more time, infection makes the leaves turn pale green and then yellow. If the weather is moist, a fuzzy violet growth covers the leaves. Downy mildew can also start on the older outer leaves and

Downy mildew



15

Gerald Holmes, Valent USA Corporation,
1571075 Bugwood.org



move through the plant to the younger, inside leaves. Downy mildew is worse in cool weather. Plants with downy mildew get other diseases more easily.

Disease cycle: Over winter, the fungus lives in parts of diseased plants left in the field. Downy mildew affects onions, garlic, leeks, and other alliums. Spores blow in the wind on to leaves of other plants. Wet weather with dew, fog, or rain causes more infection.

Management: Use the prevention techniques listed above and also:

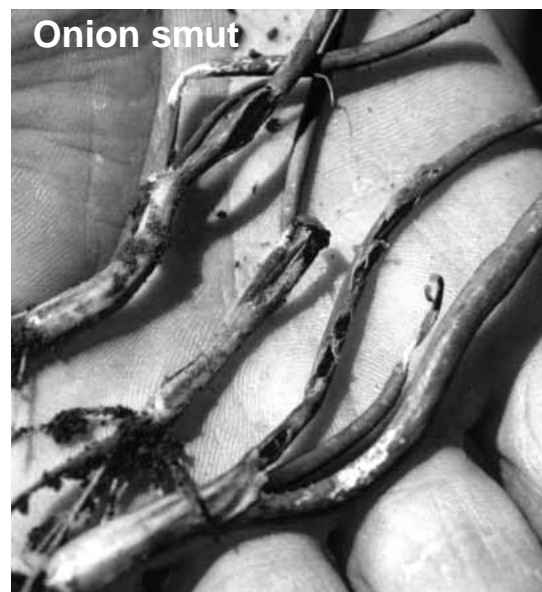
- ❖ Plant seed that is disease - free.
- ❖ Plant in soil that drains well.
- ❖ Plant to give good air flow between plants; don't plant too close together.

Onion smut

Description: A fungus invades young seedlings and kills them. At first, the leaves on seedlings get a blister that is brown-black. Most seedlings die 3-5 weeks after they sprout and get infected. Some plants die slowly. Seedlings that live do not form bulbs. If bulbs form, they become covered in black spots. Plants with onion smut get other diseases more easily.

Disease cycle: The fungus lives in soil for many years. When onions, leeks, or shallots are planted into the infected soil, the spores sprout and infect new seedlings. Over winter, the fungus lives in parts of diseased plants left in the field. Spores blow in the wind on to leaves of other plants. Wet weather with dew, fog, or rain causes more infection.

Management: Use the prevention techniques listed above and plant seed that is disease-free.



Howard F. Schwartz, Colorado State University,
5361506 Bugwood.org



Purple blotch

Description: A fungus invades onions, garlic, and leeks and causes plants to die early. At first, you see small, brown, water soaked areas on onion leaves, flower stalks, and flowers. As the spots get bigger they have light and dark purple areas that look sunken. The edge of the spot is reddish or purple with a yellow halo. With more time, infection makes the leaves and stems turn yellow, drop over, and die. This can take many weeks.

At harvest or in storage, onion bulbs can be infected. The fungus gets into the bulb through the neck or through



Purple blotch

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5362939 Bugwood.org

cuts in the bulb scales. If a bulb is infected that part of the bulb slowly dries out. The area that was infected becomes papery.

Disease cycle: Over winter, the fungus lives in parts of diseased plants left in the field. In warm wet spring weather the fungus makes spores. Spores infect leaves, stems, and flowers. Spores need rain or moisture to infect plants.

Management: Use the prevention techniques listed above and also:

- ❖ Plant seed that is disease - free.
- ❖ Plant in soil that drains well.
- ❖ Plant to give good air flow between plants; don't plant too close together.

Soft rot

Description: A bacteria invades onions, garlic, and leeks and causes them to rot in storage. At first, you see water-soaked areas near the neck of the bulb. It moves down along one or more scale. Later, the areas are soft and slimy. The fluid stinks.

Disease cycle: The bacteria affects many different vegetables and plants. Bacteria is carried to onions, garlic, and leeks on rain, tools, clothing, insects, and running water. Bacteria infects plants that are already weak from another cause. Bacteria also enters a plant through a cut or wound. Onion maggots can carry the bacteria and adult flies can lay infected eggs on onions.



Management:

- ❖ Keep plants healthy.
- ❖ Prevent cuts and wounds on plants.
- ❖ Control onion maggots.
- ❖ Let tops mature before harvest.
- ❖ Let tops dry well.
- ❖ Handle onions carefully so they don't bruise.
- ❖ Destroy bulbs that have rot.



Soft rot

S. K. Mohan, 5367341 Bugwood.org

Insect Management

The common insects that attack onions, garlic, and leeks are aster leafhopper, black cutworm, onion maggot, and onion thrips.

Aster leafhopper

Description: The aster leafhopper is an olive-green, wedge shaped insect about $\frac{1}{8}$ inches long. If you use a magnifying glass you will see 6 spots on the back of the adult's head. Adult leafhoppers are very active and quick. They jump, crawl, or fly when they are disturbed.

Immature leafhoppers are called nymphs. They have a similar shape to the adults but they are cream colored and do not have wings. Nymphs do not jump or fly but they crawl quickly.

Life cycle: Leafhoppers migrate in the spring from states near the Gulf of



Aster leafhopper

David Cappaert, Michigan State University,
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Mexico. Warm, southerly winds carry the leafhoppers north. By June and early July there are many leafhoppers in the Midwest. Adults begin to lay eggs in leaves of certain plants, including many weeds and crop plants. Nymphs hatch 5-7 days later. They grow to be adults in 20-30 days. Usually there are 2-5 generations per year.

Damage, symptoms: Both the adults and the nymphs pierce the leaves and suck sap out of the plant. The main damage aster leafhoppers cause to crops is infection with aster yellows virus. If a leafhopper feeds on a plant that has the aster yellows virus, then the leafhopper carries the virus. When that insect feeds on a plant, it can transfer the aster yellows virus. In alliums, the aster yellows virus disease symptoms will appear about one month later. Plants infected with aster yellows virus turn yellow and weak. They produce smaller bulbs. Stems and leaves grow twisted. Bulbs infected with aster yellows virus do not dry well.

Management: Remove weeds from field edges. Keep insects off plants by using floating row covers, which are special sheets of white fabric made of spun-bonded polypropylene. This fabric lets sunlight and water through the fabric but stops insects.

Row covers stop leafhoppers from feeding on onions, garlic, or leeks. Be sure the fabric covers the crop from the beginning of the growing season

until 30 days before harvest. You can lay the fabric over the crop or use wire hoops to hold it up. Be sure to seal all 4 sides of the fabric to the ground so insects don't fly under it. You can hold the edges down by burying the fabric in the soil, or use weights to hold it down such as metal posts or lumber.

If you decide to use chemical sprays to control aster leafhoppers you need to know how many leafhoppers you have and whether they carry the virus. There are yellow sticky cards that collect insects so you can see them. Put these cards in the field at transplant time. Choose a spot just above the crop and a few rows in from the edge.

When you see leafhoppers on the cards, begin to collect insect samples every week. Contact your local county Extension office for information on what percent of the current leafhopper population is infected. They can help you decide if you need to spray. If you spray, continue until 30 days before harvest.

Some growers plant more than they need so that if some plants get infected with aster yellows virus then there are still enough left to produce a crop. Growers also try to grow alliums away from other plants that can be infected with aster yellows virus. Some of these plants are lettuce, celery, carrot, parsnip, parsley, dill, pepper, tomato, cucumber, and sweet corn.



Black cutworm

Description: Cutworms are larva of a grey moth that flies at night. Cutworms eat young leaves and stems. They can cut off many seedlings in one evening. The large (1.5-2 inches) fat worm curls up into a tight C shape when it is disturbed. They are grey with black dots along the sides.

Life cycle: Moths fly into the Midwest from southern states in late May. They lay eggs on low growing plants or pieces of plants leftover from the year



Black cutworm

W.M. Hantsbarger, 5361045 Bugwood.org

before. They like to lay eggs on grassy plants. The eggs are either laid one by one or in a cluster. Eggs hatch into larva which are also called cutworms.

The young cutworms feed at the tips of the plants. Older cutworms feed at the soil surface or just below. Older cutworms feed at night or on cloudy

days. When they are not feeding they burrow into the ground. Usually there are 3-4 generations per year. The first generation does the most damage because it eats seedlings.

Damage, symptoms: One large cutworm can destroy many plants in one evening. They often pull the stems into their burrow.

Management: Control grassy weeds. Do not plant in low, wet areas or places where grassy plants grew the year before.

If you decide to use chemical sprays to control cutworms you need to know how many cutworms you have. After you see feeding damage, look for cutworms every week. Walk between two rows of plants and shake every plant on either side along a 5-foot length of row. Count the larva that fall. If there are more than two cutworms per foot of row they might cause enough damage for you to think about a spray.

Onion maggot

Description: Onion maggots are the larva of a fly that looks like a housefly. The flies are ¼ inches long. Their wings overlap each other when the fly is resting. The larva or maggots look like cream colored worms 1 inch long. The maggots do not have legs. Their head end is pointed.

Life cycle: Onion maggots overwinter as pupae in the soil or old onions. When the pupa forms an adult fly, it comes out in mid-May. The fly lays



eggs on the soil surface at the base of plants in the onion (allium) family. When the larva or maggot comes out of the egg it goes to the bulb and starts feeding. Later in its growth cycle it forms a pupa in the soil. Three to four weeks later another generation starts.

Damage, symptoms: Onion maggots eat the plant at a spot just below ground. Sometimes they eat the whole seedling. If the plant is older and has started to form a bulb, the maggots can burrow into the bulb. After this the plants wilt and turn yellow. Plants that have been eaten by onion maggot can start to rot.



Onion maggot damage

DR. MICHAEL HAVEY, HAVEYLAB.HORT.WISC.EDU

Management: If you see the damage it is already too late to control onion maggots. The best way to control damage from onion maggots is to prevent them from coming into your

field. Destroy old plants and bits of old stems and leaves. Remove old onions, garlic, or leeks from the fields. If you have onions, garlic, or leeks that did not sell, do not pile them. Cultivating the field in the fall can help kill pupae. If you have enough space or have fields that are far from each other you can rotate crops. New plantings have to be at least ¼ mile away from fields that had onion crops the year before.

Onion thrips

Description: Thrips are tiny insects you will see more easily with a magnifying glass. They are 1/6 inch long. Thrips have a long, shiny body that is pale yellow or brown and pointed at both ends. Their wings have no veins. The edge of their wings have long hairs. Immature thrips (called nymphs) are smaller than adults. Nymphs do not have wings.

Life cycle: Onion thrips overwinter as adults or nymphs on onion crop plants and pieces of plants leftover from the year before. Thrips also overwinter on weeds in the field and near the edge of the fields.

Females can reproduce without mating. They lay eggs beneath the leaf's surface. Eggs hatch in 5-10 days. Nymphs grow into adults in 15-30 days. One or two weeks after they hatch, nymphs move into the soil and stop feeding. There are 4-8 generations of thrips a year. There are more thrips in hot, dry weather.



Damage, symptoms: Thrips use their mouthparts to rasp their jaws like a saw blade. Then they suck the plant sap. Tiny white spots form on leaves. Spots can form into blotches and silvery streaks that shine in the sun. Later, these areas become dry and yellow. If there are many thrips feeding, leaf tips can turn brown. Bulbs of onions, garlic, and leeks eaten by thrips are smaller and not shaped well.



Onion thrips

Management: Thrips are hard to control because they are small and hide between leaves. The leaves protect them. Thrips also reproduce quickly. Keep your fields and the edges of neighboring areas as weed-free as you can to prevent thrips. You can add helpful insects (beneficial insects) such as lady bugs to eat thrips. There are some natural sprays that you can use against thrips. Examples are soap spray, sulfur, neem, and a beneficial fungus called *Beauveria bassiana*. If you are an

organic grower, check to be sure these sprays fit the rules for organic certification.

Notes

Notes: _____

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