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ORGANIC GARLIC PRODUCTION

CURRENT TOPIC

By Janet Bachmann, NCAT Agriculture Specialist, June 2001
With special thanks to the Garlic Seed Foundation

Garlic is well adapted for production in all parts of the U.S. Yield and quality vary with climate, region, altitude, soil and pH, cultural practices, and variety of garlic. The term “biological elasticity” describes garlic’s ability to acclimate to these factors over time. No one practice is best suited for every situation. You will want to talk with other garlic growers in your area and experiment with different cultural practices and varieties to discover the best combination for your operation.

Cultivated garlic, *Allium sativum*, is a member of the lily family. It may generally be divided into two subspecies: *ophioscorodon* (hardneck or topset garlic) and *sativum* (softneck or artichoke garlic). The former produces elongated flower stalks (technically called scapes) and bulbils at the top of the stalk. Soft-neck garlic does not produce bulbils, *except* in times of stress. It invests its energy instead into the production of larger bulbs and more cloves per bulb. While both bulbils and underground cloves can be replanted, bulbils will take longer – up to two seasons – to produce mature bulbs, and will require special care because the young plants are very small.

Hardneck types like rocambole and continental usually do better in colder climates. The cloves are larger and easier to peel. A few variety names are ‘Spanish Roja’, ‘German Red’, ‘Carpathian’, and ‘Music’.

Softneck garlic types like silverskin or artichoke are not recommended for northern climates. Numerous strains exist, having been selected over the years by the various companies that produce them for dehydration, or by growers producing them for the fresh market. One reason why industrial farms grow softneck garlic is that the planting process can be mechanized: since they don’t produce a scape, the cloves can be planted upside down. Topsetting garlic cloves must be set upright. Fewer varieties of softneck exist, compared to topsetting. The varieties ‘California Early’ and ‘California Late’ comprise 90% of the softneck types grown.



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Seed Sources

Although garlic is listed in many commercial seed catalogs, “Buy local!” is the advice from David Stern (1) of the Garlic Seed Foundation. If you buy from out of state, it will take a couple of years for the garlic to acclimate. Mr. Stern says there is an ongoing debate about varieties. The USDA lists 380 garlic accessions.* The Seed Savers Exchange catalog lists 400 varieties. But if you were to grow them on your own farm, after a few years—because of “biological elasticity”—they may all look alike. For example, ‘German Red’ will be red in one location, but white in another because of differences in climate or soils. According to the USDA, probably only 20 to 30 genotypes exist.

Do not buy garlic for planting from the produce section of a grocery store. This garlic has been treated with anti-sprouting agents and is most likely grown in distant states. Appropriate seed may be located through:

- 1) Local farmers at farmers’ markets or roadside and farm stands.
- 2) Garlic Seed Foundation list, sent on request if you furnish a SASE.
- 3) Other seed-saver organizations, such as Seed Savers Exchange and Southern Exposure Seed Exchange.
- 4) Commercial seed catalogs.
- 5) Internet.

Organic planting stock is now required by USDA—or will be in 2002—for Certified Organic Growers.

Soil Fertility

Garlic is a high-value crop. Give it your best ground. Garlic is a heavy feeder. It needs full sun and a full range of available nutrients. If you want recommendations on which nutrients are needed, ask for the recommendations for onions when you send a soil sample to a soil-testing laboratory. A pH of 6.8 to 7.2 is ideal: many nutrients are tied up in soils that are more alkaline or more acidic.

Garlic will grow in almost any well-drained, friable soil—preferably with high organic matter content. High organic matter aids in soil water-holding capacity. Begin soil preparation the year before planting. In his book *Growing Great Garlic*, Ron Engeland (2) recommends building up the soil over a period of 1–2 years using animal and green manures *before* the garlic is planted.

Provide additional nitrogen, if needed, through supplemental use of organic fertilizers. Nitrogen can be applied in the fall at planting *if* a slow-release fertilizer such as soybean meal is used. In general, nitrogen-containing fertilizer should be applied in the spring as soon as

*An ‘accession’ is plant breeders’ jargon for seed that came from a common stock. If you have several samples of the same species that came from different sources, they are different accessions. Samples coming from the same source in different years are also considered different accessions.

the plants begin growing, and every two weeks until the plants have four leaves. It is best *not* to apply nitrogen when the bulbs are beginning to enlarge, since it will encourage excessive leaf growth and reduce bulb size. Additional information on soil fertility management, cover crops and green manures may be obtained from ATTRA.

If foliar feeding is used to supply nutrients, it should be done prior to the 4th or 5th leaf stage. A good spreader-sticker should be used to hold the solution on the garlic's waxy leaves.

When to Plant

Vernalization from a period of cold is required in order for the mother bulb to split into cloves. Fall planting is recommended in all parts of the U.S. For spring planting – not recommended – the bulbs need to be refrigerated at 40°F for 40 days. Fall-planted garlic grows rapidly when the weather warms in spring. Garlic is day-length sensitive and will bulb in specific areas according to the sun, often near the summer solstice. In the North, plant in October before the ground freezes. This gives the plant time to make good root development but not enough time to make leaf growth. Where winters are milder, garlic can be planted from November through January.

How to Plant

Garlic is propagated vegetatively from the cloves in each bulb. The size of both the clove and the bulb is an important consideration when selecting planting stock. Grade your garlic for both size and quality. Discard anything that is diseased, small, soft, damaged, or discolored. This is time-consuming, but important.

Crack the bulb into individual cloves. Plant cloves basal plate-side down. Where winters are mild, plant cloves 1 inch deep; where winters are severe, put them 2–4 inches deep.

David Stern says garlic loves mulch. Mulch will help improve winter survival, suppress weeds, conserve soil moisture, and prevent soil erosion. It will also increase yields by keeping the soil cooler. Garlic quits growing when the soil temperature increases above 90°F. Mr. Stern establishes a winter cover crop/mulch on his New York state farm by planting oats in late August or early September. The oats are 6 inches tall when he plants garlic. He uses a disc-furrower on a tool bar behind his tractor to cut slices through the oats. Garlic is set into the slices. The oats continue to grow until killed by winter frost.

Garlic can also be mulched with clean straw or other organic material immediately after planting. The garlic will have no trouble pushing through an inch or more of mulch. However, mulch will make harvesting by machine difficult or impossible.

Garlic is often planted in raised beds for ease of digging, good soil drainage, and reduction of soil compaction. In-bed spacing of 6 inches by 12 inches is best, except for the variety 'Music,' which requires a spacing of 12 inches by 12 inches to produce the largest bulbs.

Seed Stalks

Hardneck varieties put up a tall, woody flowering stalk or scape that grows bulbils at the top. If the plant is allowed to put its energy into these bulbils, the bulb forming below the ground will be 1/3 smaller than if the scape is cut. Cut the scapes when they are young and tender and cook or sell them! They can be used for pickles, pesto, or stir-fry. Mr. Stern harvests 300-400 pounds of scapes per acre and sells them at \$3 per pound. He advises cutting or snapping off the scapes on a sunny day so that the wound will heal quickly. The scapes should be removed from the field as a sanitary measure to lessen the potential for disease.

Irrigation and Labor

One inch of rainfall per week or the equivalent in irrigation is needed for best garlic growth. Drip or trickle irrigation is recommended. Stop irrigating at least 2 weeks prior to harvest.

Labor needs vary seasonally. David Stern notes that 20-25 “human interventions” are needed between the time he buys bulbs and the time he sells bulbs. Planting and harvest are critical times. You should keep this in mind if you are considering expansion of your garlic planting. If you double your acreage, you will also double the time spent on each process, such as cracking the “seed” bulbs into cloves for planting, cultivating, and digging. Storage space needs are also doubled. Mr. Stern cautions that a garlic grower makes a large investment in this crop: tasks must be done on time or the crop and the investment will be lost.

Pest Management

Most pests that attack onions will also attack garlic. These include onion thrips, onion maggots, grasshoppers, and gophers. Diseases are caused by a number of fungi, bacteria, nematodes, and viruses. Learning to identify the symptoms is the first step in management. *Growing Great Garlic* has a section on pests and diseases that gives good descriptions and management techniques. Two other excellent resources are *Compendium of Onion and Garlic Diseases* (3) and *Integrated Pest Management for Onions* (4). The Cooperative Extension Service can also help in pest identification.

Onion thrips are probably the most common insect pest that attacks garlic (5). The nymphs and adults rasp the leaves and other plant tissue to encourage the release of sap, which is then consumed. When damage is severe, the entire plant may wilt and die (6).

Onion thrips begin to migrate when weeds in surrounding fields begin to dry up. Monitoring thrips with hot pink sticky traps should start before this migration begins. Since adults and nymphs will inhabit weedy areas surrounding the field, keep these areas weed-free to reduce thrips infestations. After the crop is harvested, the tops should be raked together and burned to reduce overwintering populations.

Several species of lady beetles, as well as the minute pirate bug, are predators of onion thrips (6). The predatory mites *Amblyseius cucumeris* and *A. barkeri* are also reported to attack onion thrips. However, Carol Glenister (7) of IPM Laboratories in Locke, New York, who has researched the use of predatory mites for control of onion thrips, says the results were not

encouraging. Thrips migrate in large numbers from neighboring areas that are drying up, and the mites find it difficult to prey on them all at once. Glenister suggests that release of beneficial insects is not the answer, but ensuring natural habitats for them is. Habitat enhancement for natural predators and parasites is discussed in the ATTRA publication *Farmscaping to Enhance Biological Control*.

There are several "least-toxic" pesticides that may reduce thrips populations. According to Dr. Richard Lindquist, entomologist at Ohio State University, a mixture of M-Pede® (insecticidal soap) and SunSpray Ultra-Fine Spray Oil® controlled western flower thrips—a closely related thrips species—in a greenhouse trial (8). Neem oil, a botanical pesticide extracted from the neem tree, *Azadirachta indica*, has shown good control of a variety of agricultural pests. Dr. Lindquist indicates that it provided control of flower thrips in the greenhouse after a series of four weekly applications. (Note: Neem is not a good rescue treatment, but works as an insect growth regulator and should be applied early in the crop cycle.)

Certain cultural practices can help to reduce the incidence of diseases in garlic. Crop rotations away from other species of alliums and from fields with a history of disease problems are recommended. Sanitation is another important aspect of disease control. If you see anything yellowing or misshapen in the field, it should be removed. Culls and diseased foliage should also be removed from the field after harvest. Purchasing disease-free stock is another way to avoid problems.

Weed Control

Good weed control is *essential* in garlic production. Alliums are poor competitors; weeds can cut garlic yields in half, and lower the quality of the crop (9). Planted in the fall and harvested in the mid-summer of the next year, garlic will be in the ground nine months. It is therefore vulnerable to competition from winter and summer annual weeds. Weed competition, even early in the growth of the crop, can reduce yields. In addition to reducing yield and quality, weeds also interfere with mechanical harvesting equipment.

Mulching new plantings has already been mentioned as a way to control weeds. If mulch is used, it should be thick enough to last until harvest. However, as noted earlier, if mulch is used, garlic will have to be dug by hand rather than machine harvested.

Soil solarization is a process that uses heat from the sun for controlling many soil-borne plant pathogens, weeds, and nematodes. Basically, when clean-tilled soil is covered with clear plastic for several weeks during the hottest part of the summer, solar heat build-up under the plastic kills many weed seeds and disease-causing organisms. The bulletin *Soil Solarization: A Non-Chemical Method for Controlling Diseases and Pests* gives more specific details (10).

Cultivation is, of course, another method of weed control. If the soil is not mulched, various types of cultivators or tillers can be used to take care of weeds in the furrow and on the sides of the beds. The weeds in the plant rows may be removed by hand cultivation. David Stern has adapted his equipment for machine cultivation with small discs that throw dirt against the plants. The garlic leaves are not covered, but small weeds are eliminated.

Flame weeding works with garlic as well as with onions. At six commercial organic farms in Europe, flaming was tried on onions before the four-leaf stage and also later in their development (11). Flaming the younger plants resulted in damage to the onions. However, flaming at a later stage was successful, though too much heat damaged the onions. Flaming also works best with more mature garlic plants, and with the variety 'Music.' Field conditions such as uneven ground, inconsistent tractor speed, or high winds can affect the degree of success with this technique. For small-scale plantings, backpack flamers from construction supply outlets should work fine.

Harvest and Storage

Gauging the right time to harvest is very important. Garlic will double in size during its last month of growth, and if dug too soon, the skins won't have formed around each clove. Hard-neck bulbs, if dug too late, may have begun to spread apart in the soil. According to David Stern, harvest often begins when the leaf tips start to brown. Ron Engeland uses the number of green leaves left on the plant to judge if the bulb is ready for harvest. On an average, he harvests when about six plant leaves are still green. Some growers harvest when plants are 40% browned and 60% green. Mr. Stern notes that leaf conditions will not give you certain knowledge that it is time to harvest. Browning of leaves may be the result of damage or disease. You need to dig up a plant to judge the bulbs. The outer skin should be tight, the bulbs fully developed and well formed. Mr. Stern recommends digging sooner rather than later. If garlic becomes too mature before harvest, the cloves will begin to crack apart while still in the ground. However, if the garlic is pulled at a slightly immature stage, the leaves, which serve as wrappers for the cloves, will continue to translocate nutrients to the cloves.

In small-scale plantings, garlic can be dug with a garden fork. For larger acreages, several tools are available for undercutting and harvesting garlic. Bed lifters, potato diggers, or subsoilers can be used to loosen garlic from the soil. (These will not work if heavy mulch remains.) The Garlic Seed Foundation can provide information on building your own harvesting equipment or referrals to manufacturers.

The garlic still needs to be removed from the field by hand. Field grading should be done immediately to remove any damaged or diseased plants, a standard practice for disease prevention. Sort garlic into three categories:

- Small bulbs can be cleaned for sale or your own kitchen.
- Medium-sized bulbs are cleaned in preparation for sale. One harvesting debate involves whether or not to wash bulbs. Ron Engeland states in *Growing Great Garlic* that he doesn't want to invite mold and decay that might result from having wet bulbs as a result of washing, and that bulbs grown in light soils with lots of humus clean up fairly easily. Garlic grown in heavier soils is more difficult to clean. David Stern's method for cleaning garlic begins by holding a bunch of 6-8 bulbs in one hand and spraying them with the garden hose while rotating his wrist so that all sides are washed. He then lays the garlic – not bunched – on racks in the greenhouse and off the ground to dry overnight. The plants are bunched the next day, and stay bunched until he is ready to

braid. Mr. Stern digs and cleans in the afternoon, taking care not to dig more than he can clean that day.

- Large bulbs are saved for your own planting stock. These should not be washed, but hung in a covered barn or shed to dry. Fans may be used to increase air movement in wet years. (California is the only place where garlic is dried in the field. Growers commonly lay the bulbs in the field for a few days to dry, covering the bulbs of one row with the leaves of the next to prevent direct exposure to sunlight.)

Before garlic is stored, it must be properly cured or dried. According to Mr. Stern, the garlic needs to hang dry for at least 10–14 days to help the neck cells constrict and hold the juice in the bulb. He suggests this be done with the stem and roots still on. After a couple of weeks they may be clipped off, leaving $\frac{1}{4}$ to $\frac{1}{2}$ inch of the stem and roots. When the outer skins are dry and crispy, the garlic is ready for storage or sale. It can be stored in *clean* onion bags.

According to the publication *Commercial Storage of Fruits and Vegetables* (12), garlic will keep for 6 to 7 months if it is stored at 32° F and at 65 to 70 percent relative humidity. It is important to keep temperature and humidity constant. Any variation in either will initiate sprouting. High humidity will keep the bulbs from dehydrating. A walk-in cooler can make a suitable storage facility. A 25-watt light bulb and a thermostat can be used to provide heat when needed. A fan will keep air circulating.

Stored garlic should be checked monthly. White mold is a postharvest disease that may show up in stored garlic. It is caused by the fungus *Penicillium*, which will sporulate and spread.

Marketing

Consumption of garlic in the U.S. has risen from $\frac{1}{2}$ pound per person in 1985 to 3.1 pounds per person in 1999. Of the total garlic harvested in the US, 60% is dehydrated, 30% is sold fresh, and 10% is processed for oil. Garlic is an excellent crop to promote as a local specialty. It can be sold in a number of forms for a number of uses.

- *Garlic greens* are the leaves of the tender, immature garlic plant grown from whole bulbs planted 4 inches apart in the fall. They are harvested at ground level, bunched (2" across at base), banded, and rinsed. The leaves need to be tender, and approximately 8–10" tall. New leaves will regrow up to two additional times. Harvest season is approximately mid-March to mid-April.
- *Garlic scapes* (or flower stalks) should be cut from the plant when tender, curled, and no longer than 20" total and/or $\frac{3}{8}$ " in diameter. Harvesting in mid-day sun is a good cultural practice. They should be rinsed, drained, bagged, and refrigerated. These are living vegetable matter and must not dry out or mold. Monitoring in storage is necessary, and yellowing scapes must be removed.
- *Garlic Scallions* are immature plants. They can be grown small cloves planted in either fall or spring. They should be harvested when the plant is 12" above ground and 14" total. The entire plant is dug, outer leaf or two peeled down and off, and rinsed clean.

The roots should be left on and free of dirt. The article suggests packing these scallions for market in banded bunches of 6 with 12 bunches per poly bag or waxed and lined box. No bulbing at the base is acceptable, since this will be tough and inedible. No scallion should be less than 3/8" in diameter.

- *Bulbs with leaves* attached may be braided, with or without dried flowers or herbs, and sold as ornamental edibles. Instructions for making garlic braids are included in the enclosures.
- *Single bulbs* can be sold for food or to other growers for seed.

Resources

The *Garlic Press*, a newsletter published by the Garlic Seed Foundation, covers tours, festivals and other events, trial planting results, drying and production information, equipment, and other topics. The Foundation maintains an extensive library and has a bibliography on garlic that is available upon request. David Stern (1), Foundation director, is willing to accept calls and answer questions. He will also refer you to growers and researchers around the world.

The 1991 publication *Growing Great Garlic* by Ron L. Engeland (2) covers the history and evolution of garlic, site and soil preparation, harvest, curing, and storage. It tells which strains to plant, when to plant, how to plant, when to fertilize (and when not to fertilize), when to prune flower stalks and when to harvest, plus how to store, market and process the crop. The author provides updated information on varieties in a 1995 supplement.

The Cooperative Extension Service in many states has bulletins on conventional, and occasionally on organic, production of horticultural crops.

ATTRA's publications *Overview of Organic Crop Production*, *Sources for Organic Fertilizers & Amendments*, *Sustainable Soil Management*, and *Organic Allium Production* may also be useful to read. These materials are available from ATTRA upon request.

References:

- 1) David Stern, Director
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Created in 1984 over a love of garlic potluck suppers, the Garlic Seed Foundation has grown to an international organization of over 1,000 members, primarily centered in the Northeast U.S. Objectives have been to educate, promote, and have some fun. GSF acts as a clearing house of information and research data. Its newsletter, The Garlic Press, is published about 4 times per year. Yearly membership fee is \$15.00 and includes a copy of Garlic, a cooperative report written by Cornell University and the GSF. Also available

from the Foundation are a number of reports, fact sheets, videos, books, a garlic bibliography, and an annual listing of available planting stock. Mr. Stern is willing to accept calls with specific questions.

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Available from:
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Okanogan, WA 98840
509-422-6940
E-mail: filaree@northcascades.net
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IPM Laboratories, Inc.
Main Street
Locke, NY 13092-0300
315-497-2063
E-mail: ipmlabs@ipmlabs.com
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Thorne Hall, 1680 Madison Avenue
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Additional Resources:

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Covers a broad range of garlic production information including history, varieties, soil and fertility, planting, mulching, cultivation, pests, scape removal, harvesting and handling, and markets. Available from the Garlic Seed Foundation for \$3.00 (free with membership).

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Chapter covers lifecycle and control options for bacterial soft rots, onion smut, downy mildew, white rot and a number of other allium diseases.

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Walker, John C. 1952. *Diseases of Vegetable Crops*. McGraw-Hill Book Co., New York, NY. 529 p. Library of congress card # 51-12826.

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