

## DESCRIPTION

Cultivated garlic, *Allium sativum*, is a hardy, cool-season perennial, although in some areas of extreme cold it may not survive the winter. A relative of onions, chives, and leeks, garlic produces bulbs with flat, solid leaves. As the garlic bulb matures, it becomes segmented into a cluster of fleshy cloves (Figure 1) enclosed in a white or purplish parchment-like outer sheath. Bulbs may contain 5 to 16 cloves, depending on variety (Table 1).

Each clove is made of two modified mature leaves around an axis with a vegetative growing point. The outer leaf is a dry sheath, while the base of the inner leaf is thickened, making up the bulk of the clove.

Although garlic is propagated from cloves, “top-setting” varieties may be propagated from bulblets or bulbils that form on the terminal end of a hollow seedstalk (scape) that develops from the main bulb before harvest. Bulbils form in a globe-shaped pod called a spathe. The outer whitish sheath of the spathe will eventually split, exposing a cluster of 10 to 40 brown, yellow, or purplish bulbils that can vary from the size of a grain of wheat to a kernel of corn.

A cluster of tiny white or purplish flowers may also form among the bulbils. These flowers are sterile; garlic produces no true seed.

Garlic is of somewhat limited nutritional value since most people eat it in relatively small amounts (although it is more nutritious than onions on a fresh weight basis). A 2-g serving of garlic will provide 3 mg of potassium, 0.4 g of carbohydrate, and trace amounts of calcium, fiber, iron, and vitamin C (Hathaway, 1993).

## SUGGESTED VARIETIES FOR NEW MEXICO

There are generally two types of garlic: those that send up a seed stalk (hardneck varieties) and those that don't (softneck varieties) (Table 1). Under certain conditions, softneck varieties can send up a seedstalk, especially if

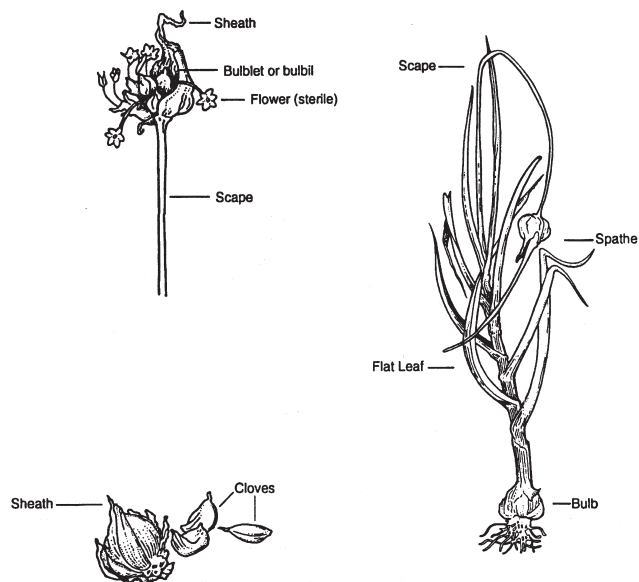


Figure 1. Garlic (top-setting) plant parts.

stressed for water or damaged by cold weather. Hardneck (subspecies *ophioscorodon*) types like Rocambole and Continental usually do better in colder climates and are larger and easier to peel. Softneck (subspecies *sativum*) types like Silverskin and Artichoke have been cultivated over a longer period of time and tend to be better adapted over a great range of climatic conditions. Softneck types also tend to hold up better in storage due to their tighter skins.

Below is a suggested list of varieties a new garlic grower may wish to consider. Varieties should be evaluated the first year to determine their adaptability, yield potential, and quality characteristics for a particular climate and market.

<sup>1</sup>Extension Vegetable Specialist and Assistant Professor, Department of Extension Plant Sciences, New Mexico State University.

**Table 1. Garlic Varieties, Types, Average Bulb Weight, Average Number of Cloves Per Bulb, Cloves Per Pound, and Pounds of Cloves Planted Per Acre**

*Variety	Type	Avg. bulb wt. (lb)	Avg. no. cloves/bulb	No. cloves/lb	**lb of cloves planted/ac
'Asian Tempest'	Asiatic hardneck	0.224	5.5	27.0	1,613
'Inchelium Red'	Artichoke softneck	0.125	8.9	76.9	566
'Carpathian'	Rocamboles hardneck	0.103	7.8	76.9	566
'California Early'	Artichoke softneck	0.105	8.3	83.3	523
'Mild French'	Silverskin softneck	0.135	14.2	111.1	392
'Spanish Roja'	Rocamboles hardneck	0.210	11.8	58.8	741
'Skuri #1'	Artichoke softneck	0.122	11.7	100.0	435
'Locati'	Silverskin softneck	0.090	15.9	200.0	218
'German Red'	Rocamboles hardneck	0.163	9.0	58.8	741

\*Source: Filaree Farm, Okanogan, Washington, 1993

\*\*Based on 36-inch rows with cloves spaced 4 inches apart, equaling 43,560 cloves per acre.

### Rocamboles (Hardneck)

'Spanish Roja'—6 to 13 cloves per bulb; cloves brown to reddish purple; cloves easy to peel; very popular.

'Carpathian'—6 to 10 cloves per bulb; large, uniform bulbs; bulb wrappers have purple blotches; one week earlier than 'Spanish Roja'; hot and spicy garlic flavor.

'German Red'—10 to 15 cloves per bulb; very vigorous, large, deep green bulb; cloves light brown with some purple at base; hot, spicy flavor.

### Artichoke (Softneck)

'Inchelium Red'—4 to 5 clove layers with 8 to 22 cloves per bulb; bulbs over 3 inches in diameter possible; mild lingering flavor.

'California Early'—4 clove layers with 10 to 22 cloves per bulb; cloves tan to off-white with pinkish blush; mild, slightly sweet flavor.

'Chet's Italian'—4 clove layers with 10 to 20 cloves per bulb; cloves milky white or yellowish; mild flavor; severe cold gives it a stronger taste.

### Silverskin (Softneck)

'Mild French'—4 clove layers with 13 to 16 cloves per bulb; cloves vary from reddish-pink blush on yellow-white background to pink-brown; better adapted to hot, dry climates; sharp taste when raw but simple, smooth, nutty taste when cooked.

'Silverskin (S&H)'—15 to 20 cloves per bulb, usually in 5 layers; cloves off-white to tan with pink blush; good producer of large bulbs; mild and sweet taste at first but can be hot.

### Elephant Garlic

Elephant garlic, or greatheaded garlic (*Allium ampeloprasum*), is not a true garlic; it is closely related to the leek. It does, however, produce a segmented bulb similar to a garlic bulb with a mild garlic flavor. It grows well in mild to moderately cold areas. Cloves should be planted in the fall only slightly farther apart than true garlic.

### SOIL AND FERTILIZERS

Garlic grows best in a rich, deep, well-drained sandy loam to clay loam soil with a pH between 6 and 8. Heavier clay soils should be avoided because bulbs may become misshapen and are harder to dig. Garlic is a heavy feeder, and a soil analysis should therefore be taken before planting to determine soil fertility levels. In New Mexico, the main fertilizer needs are phosphorous and nitrogen.

All phosphorous fertilizer should be banded 2 to 3 inches directly below the cloves before or at planting time. Fertilizers containing any nitrogen should be banded below and to the side (2 to 3 inches) of the cloves. When the fertilizer is banded, 75 to 100 lb/ac of P<sub>2</sub>O<sub>5</sub> (0.17 to 0.23 lb/100 sq ft) are adequate; when broadcast and incorporated, higher rates may be needed.

A light application of nitrogen fertilizer (25 lb/ac of elemental nitrogen) incorporated into the beds before planting is sufficient to get bulbs off to a good start in the fall. Additional nitrogen fertilizer should be applied in the spring at a rate of 100 to 150 lb/ac (0.23 to 0.34 lb/100 sq ft) of elemental nitrogen. Apply the nitrogen in split applications (30 to 50 lb increments) at 3 to 4 week intervals beginning when plants emerge in the spring. Lightly incorporate the fertilizer in a band 4 to 6 inches to the side of the developing plants and irrigate immediately after application. Nitrogen can also be applied in the irrigation water.

## PLANTING

Garlic is generally planted in the fall in New Mexico, September to October in northern areas and October to November in southern areas. Select clean, dry bulbs, and carefully break them apart into individual cloves. Cloves should be planted the same day they are divided. When planting by hand, plant cloves with the scar (stem) end down. Approximately 200 to 2,000 lb of cloves will be needed to plant an acre (Table 1). The amount will vary depending on variety (number of cloves per pound), row width, and plant spacing.

Plant cloves by hand or with a garlic transplanter 1 to 3 inches deep and 3 to 6 inches apart. In colder areas of the state, cloves may be planted slightly deeper for winter protection. Mulching will help protect bulbs from severe cold and will help conserve moisture. Two rows are usually planted 12 to 14 inches apart on top of a flat vegetable bed 38 to 40 inches wide. Single rows may be used with narrower beds. Irrigate immediately after planting.

## PLANT DEVELOPMENT

Garlic cloves require a period of 6 to 8 weeks of cool weather (below 40°F) after planting to vernalize the plants so they will form bulbs. During the fall and winter, cloves will develop their root systems and initiate some top growth.

By early spring, the clove will have swelled considerably, forming a globular bulb with many fine roots. A pair of intertwined leaves will emerge from the terminal end of the bulb and will eventually break through the soil between February and April, depending on the weather and location. Emergence may be uneven. As the weather warms, leaf development will accelerate with flat, dark green leaves reaching a height of 1 1/2 feet or more. Keep plants well watered.

As temperatures rise and day length increases, bulb formation begins. Do not apply any more fertilizer after bulb formation begins. In June to early July, leaves will begin to turn brown and tops will fall, indicating maturity. Irrigation should be terminated at this time to avoid bulb discoloration and bulb rots. To ensure bulbs are fully mature, remove the top layer of soil from the top of a few bulbs and check to make sure the bulbs are fully divided into distinct cloves (differentiated). Digging bulbs prematurely can result in spoilage during storage, while waiting too long can result in disease and/or discoloration of the bulbs.

## TOP-SETTING GARLIC (HARDNECKS)

Top-setting garlic can be propagated either from cloves or bulbils. Bulbils should be planted in the late winter or early spring in a location where they can remain undisturbed for 1 1/2 years. In the fall of the first growing season, bulbils will form larger unsegmented bulbs called "rounds." Left undisturbed, rounds will form segmented bulbs the following summer.

Top-setting garlic will form seedstalks in the late spring. What appears to be a single leaf will emerge from the center of the plant. This hollow stalk will reach 2 to 3 feet tall and form one or more coils on the end of the stalk, terminating in a heart-shaped spathe. Seedstalks can be removed when they form to force more energy into the developing cloves. Growers wishing to produce bulbils should leave the stalk undisturbed.

## HARVEST AND MARKETING

In sandy soils, bulbs can generally be pulled by hand or dug with a garden fork. Growers may wish to run a cutter blade or rod weeder below the bulb to cut the roots, particularly on clay soils.

After pulling, garlic may be cured in several ways. Larger growers may choose to top the bulbs and trim the roots immediately, placing the bulbs in burlap bags and allowing them to cure in the field for a few days. Bulbs may also be dried in a well-ventilated shed if rainfall is a problem. Rainfall on bulbs can result in storage problems.

Bulbs may also be pulled and windrowed in the field, folding leaves over the bulbs to protect them from the sun. After a week of drying, tops and roots can be trimmed. Bulbs can then be cured further or graded and marketed.

Once bulbs are fully cured, they should be sized and graded for market. Garlic is generally marketed in 5-, 10-, 20-, and 30-lb cartons or 50-lb mesh sacks. Bulbs grown for dehydration are generally transported in bulk to the dehydrator. Garlic is best stored at a temperature of 32°F.

"USDA No. 1" garlic should be of similar varietal characteristics, fully mature, and compact. Well-developed cloves should be free of dirt, mold, sunburn, staining, sprouts, cuts, roots, and insect and mechanical damage. Unless specified, bulbs should be at least 1 1/2 inches in diameter.

Each clove will produce a new bulb containing 5 to 16 new cloves. Growers saving cloves to plant next year's

crop will therefore have to hold back 10 to 12% of their crop for planting stock. The actual percentage will depend on the variety and the quality of the bulbs as well as the total acreage to be planted.

Smaller growers may wish to store and market garlic as a “ristra” by braiding leaves into a rope or wreath. Ornamental harvest wreaths made of garlic, dried chile, yucca pods, pine cones, and dried flowers can be marketed for the fall holiday season.

## PEST CONTROL

Garlic is susceptible to most onion diseases, including Botrytis, pink root rot, powdery mildew, and purple blotch. Good sanitation and long-term crop rotation are important, as well as the application of appropriate fungicides when necessary.

Onion thrips can be a major problem on garlic. Garlic growers should also scout for damage from cutworms, cabbage loopers, and wireworms. Check with your local county Extension agent for appropriate control measures.

Garlic has a very shallow root system. Like onions, it cannot withstand weed competition. Cultivation should be very shallow to prevent root damage. Pre- and postemergence herbicides are also available for weed control.

## REFERENCE

Hathaway, C. (Ed.). 1993. *The packer*, 1993 produce availability and merchandising guide (p. 171). Lincolnshire, IL: Vance Publishing Corporation.

*Original author: George W. Dickerson, Extension horticulture specialist.*



*Stephanie Walker is Extension vegetable specialist, and has extensive experience in the food processing industry. Her primary research interests include genetics and breeding of chile peppers, vegetable mechanization, enhancing pigment content, post-harvest quality, and irrigation efficiency. She works to help commercial vegetable growers enhance the sustainability and profitability of their operations through collaboration, experimentation, and information sharing.*

Contents of publications may be freely reproduced for educational purposes. All other rights reserved. For permission to use publications for other purposes, contact [pubs@nmsu.edu](mailto:pubs@nmsu.edu) or the authors listed on the publication.

New Mexico State University is an equal opportunity/affirmative action employer and educator. NMSU and the U.S. Department of Agriculture cooperating.