

## Introduction

Garlic (*Allium sativum* L.), is a member of the Amaryllidaceae family, which also includes lilies, onions and leeks. It has been cultivated for thousands of years and is widely used for both its culinary and medicinal attributes. As Americans have become more accustomed to garlic flavor and knowledgeable about the many health benefits of eating garlic, the popularity of this crop has increased.

Garlic is native to central Asia. This is a cold climate environment where winter temperatures drop to well below zero. Over hundreds, possibly thousands, of years, garlic has adapted to a wide variety of climates. The varieties that tend to thrive best in Minnesota — those in the three purple stripe families and the porcelain family — tend to be more closely genetically related to the progenitor.

Most garlic in the U.S. is grown commercially in the mild climate of northern California. Varieties adapted to mild climates and then grown in cold climates often do not perform well and can develop a very "hot" flavor. Garlic is an adaptable species, however, and over thousands of years there are also varieties that are adapted to cold climates, often with better and more distinct garlic flavor than the varieties grown in mild climates.

Recent demand for high-quality garlic has prompted an interest in growing garlic for niche markets in the upper Midwest. To help accommodate this market, this publication provides guidelines for growing garlic in cold climates. The major areas addressed include variety descriptions, soil and nutrient requirements, cultural practices, pest management, harvesting, and storage.

## Varieties

Over the many years of selection and cultivation, garlic has lost the ability to produce fertile seeds and, in some varieties, flower stalks and flowers are not even formed. Recent research has shown that it is possible to produce true garlic seed, which eventually will improve genetic diversity in the crop. However, garlic from true seed has poor germination rates and is overall difficult to propagate initially. Despite the fact that true garlic seeds cannot be easily produced, there are many different varieties from which to choose. These varieties have been selected over the years, presumably as the result of random mutations.

Garlic varieties are broadly classified into two main categories: **hardneck** and **softneck**.

**Hardneck varieties** (*Allium sativum* var. *ophioscorodon*) produce a flower stalk, or, technically, a scape, and are often termed "topsetting" or "bolting" varieties (Figure 1). The assumption is that hardneck varieties are most closely related to wild garlic. Flowers, if they are produced, usually abort and form "bulbils" instead. These are small, aerial cloves that have the same genetic make-up as the mother plant (Figure 2). They can be used for propagation, but the bulbils that are formed from bulbils are usually small the first year after planting. Two to four years are required before marketable bulbs are produced from bulbils. Typically, hardneck garlic varieties have 4-12 cloves surrounding the flower stalk. Because of the hard flower stalk, they are difficult to braid and some do not store well.

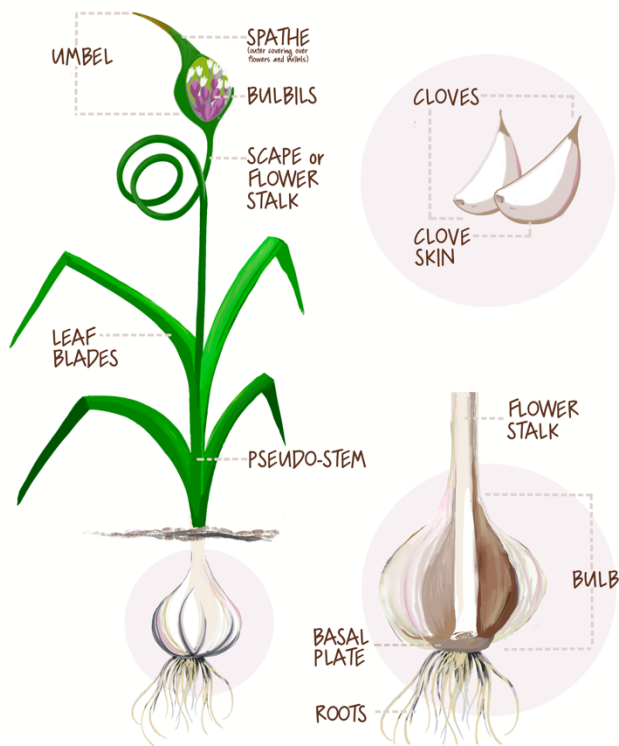


Figure 1. The parts of a hardneck garlic variety, often termed "topsetting" or "bolting".



Figure 2. Small, aerial cloves that have the same genetic make-up as the mother plant are known as bulbils.

**Softneck varieties** (*Allium sativum* var. *sativum*) do not produce a flower stalk. These are the types of garlic that are commonly used in California for commercial mass production; although more recently some hardneck varieties are being grown on a large scale in various parts of the world and imported to the U.S. as well. There are some softneck varieties that are suitable for cold climates. Softneck varieties are considered to be the most domesticated varieties due to minimal flower stalk and bulbil production. Each bulb generally contains between 10-40 cloves arranged in multiple layers somewhat like an artichoke. Softneck garlic generally has a longer shelf life than hardneck garlic and typically can be stored for 6-8 months without significant deterioration. They also are easy to braid.

Based on genetic DNA analysis there are 10 major garlic types; however, Varietal characteristics can vary tremendously from one location to another, complicating variety selection. Climate can have a significant impact on garlic flower stalk formation as well as garlic taste. For example, a variety may be considered a softneck in one location, but in other locations it may produce a flower stalk. Occasionally, only a partial flower stalk is produced and bulbils will form directly above the bulb. Since there is no standardization, some garlic seed producers will rename particular varieties, leading to more confusion. It is best to try out several different varieties for a few years and select those that do best in your area. Characteristics of the 10 major garlic types when grown in colder climates are described below. Seed garlic may be purchased from various vendors listed on the Sustainable Farming Association garlic webpage, the Minnesota Grown Directory, or from vendors selling garlic online, at Minnesota Garlic Festival, and at regional farmers markets.

## Varietal descriptions

### Rocamboles

Moderately sized plant (3-4 feet tall with scape uncurled), characterized by a scape that coils 2-3 times before straightening out. Bulbils are numerous and generally a purple color. Bulbs are off-white with purple streaks. Clove skins are brownish and easy to peel. Bulbs store for about 4-5 months. Generally performs well in cold climates. Prone to double cloves (Figure 3).

- Typical named selections include: German Red, German Brown, Spanish Roja, Russian Red, Killarney Red, Montana Giant

### Purple Stripe

Moderately sized plant (3-5 feet tall with scape uncurled), characterized by a scape with  $\frac{3}{4}$  of a coil and others just form a downwards U before straightening out. Bulbils are numerous and generally a purple color. Bulbs have purple streaks. Clove skins are brownish and more difficult to peel than rocamboles. Bulbs store for about 5-7 months. Generally performs well in cold climates. A typical bulb has 8-12 cloves and one pound of garlic will supply about 60 cloves. Double cloves rarely occur.

- Typical named selections include: Chesnok Red, Persian Star, Dugunsky, Deerfield Purple

### Glazed Purple Stripe

Similar to Purple Stripe except wrapper skins are usually more glossy in appearance and clove color is more intensely purple with fewer cloves per bulb. Environmental conditions can affect the appearance and in some cases it is difficult to distinguish a Glazed Purple Stripe for a Purple Stripe. One pound of garlic will supply about 60 cloves. Scape tends to form a full coil before straightening out.

- Typical named selections include: Purple Glazer, Red Rezan

### Marbled Purple Stripe

Bulbs actually look more similar to Rocamboles than Purple Stripes, but genetic analysis places them closer to Purple Stripes. Scapes tend to be weak in some strains and form somewhat random coils. A typical bulb has 4-7 cloves and one pound of garlic will supply about 50 cloves. Plants are very vigorous in cold climates.

- Typical named selections include: Siberian, Brown Tempest, Metachi, Estonia, Krasnodar Red

### Porcelain

Large and vigorous plants (4-6 feet tall with scape uncurled). They are characterized by a scape with loose and somewhat random coils before straightening out. Bulbils are numerous, small, and

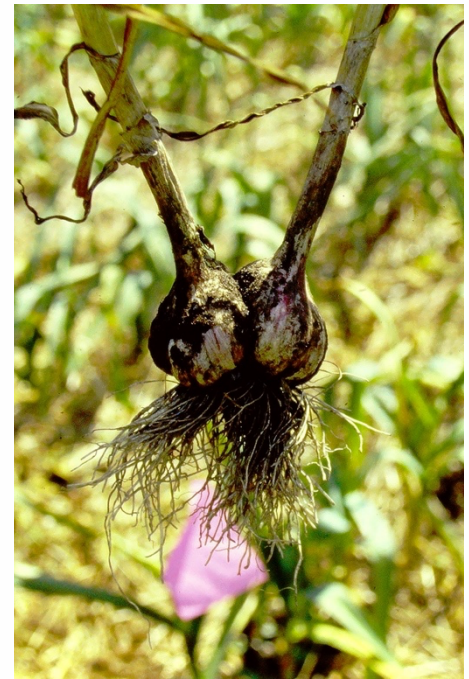


Figure 3. Rocamboles garlic plants are prone to double cloves.

generally a white color. Bulbs are large and typically contain 4-6 cloves. This characteristic is great for cooks, but growers need to save more of their crop for seed. Clove skins are smooth and white. They tend to be more difficult to peel than Rocamboles. Double cloves are rare. Bulbs store for about 5-7 months. Generally performs well in cold climates. One pound of garlic will supply about 35 cloves.

- Typical named selections include: Armenian, Georgian Crystal, Music, Polish Hardneck, Zemo, Georgian Fire, Northern White, German White, Krasnodar White

### Artichoke

This garlic type is usually a softneck but may partially bolt following cold winters (Figure 4). In some cases the bulbils form just above the bulb making the bulb unmarketable. In a mild winter only 1-2% will bolt. In a cold winter without snow cover, 70-100% may bolt. Bulbils that do appear are usually purple. Bulb color is whitish to purple blush. Bulbs typically contain 15-30 cloves and one pound of bulbs will supply about 80 cloves. This is usually the most productive softneck type in cold climates. Cloves are difficult to peel. Bulbs store for 6-9 months.



Figure 4. Artichoke garlic plants are usually a softneck type, but may partially bolt following a cold winter.

- Typical named selections include: Lorz Italian, Inchellium Red, California Early, Susanville, California Late, Early Red Italian, Machashi, Red Toch, New York White

### Asiatic

A shorter garlic plant that is about 3 feet tall when the scape is mature. Originally thought to be closely related to artichoke varieties, but further genetic analysis suggests it is a hardneck type. A flower stalk almost always forms under Minnesota conditions. Scapes generally do not curl and may be somewhat drooping with a long characteristic bulbil capsule. Bulbils are much larger than those produced on other garlic types and are usually dark purple or white in the case of Sakura/Japanese. There are usually four to eight large cloves per bulb and one pound of bulbs will provide about 50 cloves. Double cloves do occur in this type. Cloves are brownish and bulb color varies from white to pink to purple striped. Clove skins are somewhat tight making it difficult to peel. Generally they perform well in cold climates. In some selections, cloves are very prone to splitting through the bulb skins if harvested too late. Bulbs typically can be stored for 5-7 months.

- Typical named selections include: Asian Tempest, Japanese, Wonha, Sakura, Pyong Vang

## Turban

Genetically related to softneck types, but often forms a flower stalk under Minnesota conditions. Scapes are weak and tend to form a downwards U. The purple bulbils are numerous and small. There are usually 7-11 cloves per bulb and one pound of bulbs will supply about 60 cloves. Double cloves are not common in this type. Cloves are brownish and bulb color is usually dark purple striped. Clove skins are loose making it easy to peel. This type does not store well and typically only lasts 3-5 months. The advantage of this type is that it matures 1-3 weeks earlier than most other garlic types and therefore can be used for the early market.

- Typical named selections include: Red Janice, Blossom, Xian, Tzan, Chinese Stripe

## Creole

Genetically related to softneck types, but often forms a flower stalk under Minnesota conditions. Scapes that do form are weak and curl randomly, sometimes just forming a downward U. Bulbils are small and usually white to pink. There are usually 8-15 cloves per bulb and one pound of bulbs will supply about 80 cloves. Creole garlic is most suited for warm climates and mild winters. For this reason, bulb size is small (usually less than two inches) under Minnesota conditions, especially after a cold open winter. However, the deeply dark purple-red clove skins and generally sweeter taste make this garlic type unique and desirable (Figure 5). Bulb size can sometimes be improved by planting early in the spring as soon as the ground thaws. Clove skins are somewhat tight making peeling difficult. Bulbs typically can be stored for 6-8 months.



Figure 5. Creole garlic's deeply dark purple-red clove skins and generally sweeter taste make this garlic type unique and desirable.

- Typical named selections include: Ajo Rojo, Burgundy, Creole Red

## Silverskin

A true softneck type even under Minnesota conditions most years. The lack of a flower stalk makes this garlic type the best for braiding. Occasionally flower stalks will form following a cold winter. Clove number per bulb ranges from 18-40 and one pound of bulbs will supply about 90 cloves. Silverskin garlic is most suited for warm climates and mild winters. For this reason, bulb size is small (usually less than 2 inches) under Minnesota conditions, especially after a cold, open winter.



Figure 6. Silverskin garlic plants will "lay down" about one week before harvest due to their weak necks.