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Agricultural Extension Service
The University of Tennessee
PB 1610

Flowering Bulbs for Tennessee Gardens



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Flowering Bulbs for Tennessee Gardens

Mary Lewnes Albrecht, Professor and Head
Ornamental Horticulture and Landscape Design

A wealth of spring-, summer- and fall-flowering bulbs can be used to extend the garden floral display from early spring until late fall. Some of these will be winter hardy and remain in the ground year-round. Others will not survive freezing temperatures and must be replanted each spring. Many are not even true bulbs, but are often sold along side true bulbs in mail order catalogs and at garden stores. The different types of underground storage structures that are frequently called bulbs include corms, tubers, tuberous roots, tuberous stems and rhizomes. These underground storage structures collectively are called "bulb-forms" or geophytes. Geophyte comes from the Greek word *geo* – meaning earth, and the Greek word *phyte* – meaning growth or plant; therefore, geophyte means "earth growth" or "earth plant."

Bulbs:

The true bulb consists of a much-compressed, fleshy stem, the basal plate. Attached to the basal plate



Daffodil

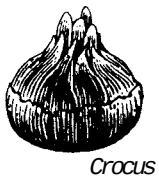
are thick, fleshy, modified leaves, the scales. The scales are organized to form two distinct types of bulbs. Laminate (tunicate) bulbs are concentric, cylindrical scales. The outer layers of scales become dry and papery, forming the tunic. This protects the bulb from disease, insect and mechanical damage. Daffodil and onion are common tunicate bulbs. The scaly (non-tunicate) bulb has numerous individual scales which readily break off the basal plate. This bulb has no tunic, making it somewhat more susceptible to disease, insect and mechanical damage. Lily is a common scaly bulb.



Lily

Corms:

A corm is the swollen base of a stem with typical stem parts: nodes and internodes. The dry, papery leaf bases enclose the swollen stem base, forming the protective tunic. The tunic, as with the bulb tunic, protects the corm from disease and water loss. A corm does not persist from season to season. Rather, a new corm is formed above the old corm formed the previous year. Gladiolus and crocus are the two most commonly grown corms.



Crocus



Gladiolus

Tubers:

Tubers are produced when the tips of a stolon (a horizontally growing stem just at the soil line) becomes swollen from stored foods. Tubers are formed below ground. Close examination of the tuber will reveal typical stem structures of nodes, the "eyes" of a potato and internodes. Besides the Irish potato, another commonly grown tuber is caladium.



Caladium

The tuberous root and the tuberous stem are commonly mislabeled as tubers. The tuberous root forms from the swelling of roots. Tuberous roots do not have any features



Dahlia

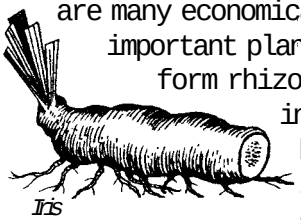
common to stems (there are no nodes or internodes present); they have all the internal and external features of roots.

On the other hand, the tuberous stem does have features of stems. The tuberous stem forms from the swelling of the area of the plant known as the hypocotyl. This is the transition region between the root and the stem.

Tuberous roots are formed on the sweet potato and the dahlia. Tuberous stems are formed by tuberous begonias, cyclamen and gloxinia.

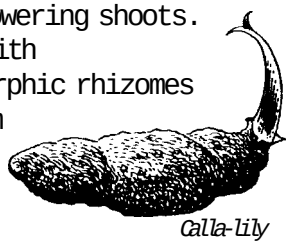
Rhizomes:

A rhizome is a specialized stem which grows just at or below the soil surface. There are many economically important plants which form rhizomes including bamboo, iris, lily-of-the-valley and many grasses.



Iris

There are two types of rhizomes found in nature, leptomorphic rhizome and pachymorphic rhizome. The lily-of-the-valley has a leptomorphic rhizome: a very thin rhizome with indeterminate growth (the rhizome does not terminate in a flower stalk; it remains vegetative), branches freely and forms many flowering shoots. Plants with leptomorphic rhizomes can form very dense mats.



Calla-lily

The pachymorphic rhizome is a large, fleshy, horizontal stem which has determinate growth. Once the terminal growing point or meristem of the rhizome forms an inflorescence (the flower stalk), the rhizome will form two branches behind the meristem. The bearded iris is a very common pachymorphic rhizome.

Culture:

Introduction

Geophytes are normally grouped based upon their ability to withstand freezing weather. Knowing this information is essential to proper culture.

Hardy geophytes, once planted and established, will survive freezing temperatures under normally good growing conditions. Examples of hardy geophytes are narcissus, tulip, hyacinth, crocus, lily and bearded iris. Semi-hardy species may be hardy in somewhat milder climates, but cannot be relied upon to survive extended exposure to below-freezing temperatures. Many of the anemones, ranunculus, bulbous iris and cannas fall into this class.

Those species which will not tolerate hard-freezing temperatures and can only be left in the ground in warm climates are referred to as tender. This includes many of our summer-flowering geophytes such as dahlia, gladiolus, caladium, callas and tuberous begonia.

The bulbous plants can be used in a number of ways and make an attractive addition to gardens: perennial border, naturalized areas, rock gardens, foundation plantings, flower borders and containers. Areas to avoid include painted walls, paved walks or driveways. Reflected heat from these areas during midday through late afternoon can cause damage to most plants. If such an area is chosen, the plants will develop and flower faster. The main disadvantage is the foliage will die back more quickly due to excessive heat.



Lily

This will result in bulb decline, since not enough food will be stored before complete die-back occurs. Planting under trees with surface roots such as Norway maple, beech or linden should be avoided, since there will be competition between tree roots and bulbs for necessary moisture and nutrients. For the same reason, vigorous shrubs, such as forsythia and Pfitzer junipers, and dense ground

covers, such as ivy, pachysandra or creeping euonymus, should also be avoided. Many larger spring-flowering, bulbous plants will compete successfully with the ground cover *Vinca minor*, periwinkle. Also consider adding many to perennial beds where the perennials can actually hide the unsightly bulb foliage as it dies.

Site Selection

When choosing a site, consider sunlight, drainage and air circulation. Most geophytes require a minimum of five to six hours of daily sunlight. Notable exceptions are lily-of-the-valley and caladium, which can thrive in shade (see the *Dictionary of Bulbous Plants* and *The Bulb Selector lists* at the end of this publication for others). For maximum growth from year to year, eight to 10 hours of sunlight are better. Adequate sunlight results in larger blooms and healthier, hardier plants due to the ability to maximize photosynthesis.

A sandy loam is the best type of soil for geophytes, since it has very good drainage coupled with good water-holding capacity. To check an area for drainage, dig a hole about 1 foot deep and fill it with water. Come back the next day and fill it again. If this second application of water drains completely in eight to 10 hours, the soil has adequate drainage. If not, the soil most likely has a high clay content and organic amendments such as compost, leaf mold or peat moss should be added to improve drainage.

The third essential criteria is adequate air circulation. Air circulation is necessary to reduce the incidence of disease with these plants.

Site Preparation

If the chosen site has poor drainage, several things can be done. Drain pipes can be laid to facilitate the removal of excess water. If this is not desirable or feasible, adding organic matter to a heavy clay soil will improve drainage. Adding up to 30 percent organic matter by volume will make a difference (spread a 4-inch thick layer of organic matter over the bed then till it into the soil to a depth of 12 inches). Adding organic matter from composts will also aid sandy soils where drainage is too rapid and water-holding capacity is reduced. If the area has such poor drainage that organic matter incorporation will not be of much benefit, raised beds can be constructed. Materials such as landscape timbers, stone or brick can be used to build raised beds. Walls can be made high enough for use as additional seating in the smaller gardens of today's urban settings. Regardless of the method chosen to improve drainage, it is essential that the soil is prepared to a 12-inch depth so fertilizers are placed in the rootzone. Bonemeal, at the rate of 4 to 6 pounds per 100 square feet of bed area, will provide plants with phosphorus, calcium, manganese and some nitrogen. A reported problem using bonemeal is that it attracts squirrels and similar pests that may dig up the bulbs. If an inorganic fertilizer is used, select one with low nitrogen and high phosphorus, such as a 1:3:1 or 1:3:2 N-P_2O_5-K_2O ratio. Check the package directions for the proper rate. Be sure to take a soil sample to determine pH. Most geophytes grow best at a pH range of 6.5 to 7.2. All nutrient amendments should be incorporated into the 2-inch layer of soil upon which the bulbs, corms, tubers and rhizomes will be set.

Selecting Plant Material

When buying any flowering bulbous plants, it is best to buy from a reputable dealer. Some minor or unusual bulbs have been illegally harvested from the wild. These should be avoided. Also, avoid the "bargain" bulbs. Much of the plant material offered at reduced prices are low grades (smaller bulbs). Low grades will not produce as large a flower or may not flower at all. More often than not, you will be disappointed in plants resulting from inferior grade material.

Besides the size or grade of the bulb, the cultivar can impact price. Some cultivars are more difficult to multiply or they are slower-growing plants. Selecting a cultivar is a personal preference, because there are hundreds of cultivars from which to choose.

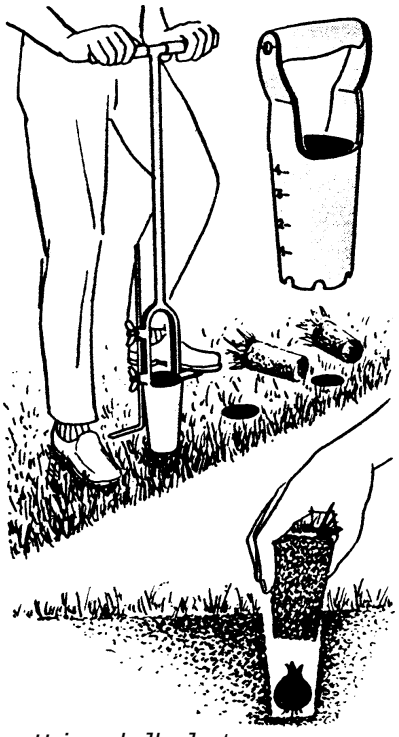
If buying bulbs at a garden center, you can pick and choose the healthy ones. If

ordering through the mail, be sure to examine the bulbs upon arrival and, if you identify bad plant material, notify the supplier. Symptoms of unhealthy geophytes include mold growing on the surface, an unpleasant odor, discoloration, a soft feel, signs of rot, feeling lightweight or a blemished surface. All are signs of damage or disease and the plants should be discarded. Use the same criteria when digging and sorting already established plants which are being thinned, divided or prepared for winter storage.

Planting Spring-Flowering Geophytes

Hardy spring-flowering bulbous plants should be planted before the ground freezes in the fall. The usual time is from late September through early November. Early planting is essential to allow for good root development before the ground gets cold. If the plant can establish a healthy, vigorous root system before the ground freezes, it will be capable of rapid growth and development in the spring.

When planting bulbous plants, it is best to mass them. Avoid lining them up like little tin soldiers or making a polka-dotted effect. Mass plantings are more appealing unless it is some large, unusual plant such as *Fritillaria imperalis*, crown imperial. If it is necessary to plant single bulbs in among trees, shrubs or rocks, it is easiest to use a hand trowel or a bulb planter. "Bulb" drill bits are now available for use with a cordless drill for planting ease. Regardless of whether planting just a few plants or a few hundred, it is extremely important that the geophytes are planted to the proper depths (see recommended planting depth in the *Dictionary of Bulbous Plants* at the end of this publication). Shallow planting increases the risk of frost damage to the plants. *The general rule of thumb for proper planting depth is 2 to 3 times as deep as the height of the bulb*. Depth is measured from the top of the bulb to the soil surface. In very loose, sandy soils, bulbs can be planted 2 to 3 inches deeper than normally recommended.



Using a bulb planter.

When planting large areas, it is easiest to excavate the entire area and lay the bulbs, corms, tubers or rhizomes in place and then backfill the area with the removed soil. When planting large areas, either arrange the bulbs in straight lines for a formal bed or in random fashion for a naturalized appearance. In either instance, the bed should be dug to a depth of at least 4 inches more than the recommended planting depth. Replace the bottom 2 inches of soil. This creates a loosened bed for root penetration. To the next 2-inch layer, mix the bonemeal or other fertilizers. Place the geophytes on this layer and fill in with about half the soil. Apply water and allow the soil to settle. Add the remaining soil and water again. Once the water has drained away, mulch the bed with several inches of leaf mold, wood chips or some other organic mulch to prevent drying, freezing and thawing through the winter. In areas where rodents can be a problem, encase the geohpytes in $1/2$ - inch wire mesh. This will prevent rodents from digging and eating the plants and still allow the shoots to emerge from the ground.

Iris

Of the hardy, spring-flowering geophytes, the genus *Iris* deserves some special attention. There are some 300 species of iris organized into 27 subgenera, sections and series. Because they easily hybridize, there



Iris

are hundreds of cultivars. Identification can become a gardener's nightmare! There are special morphological terms used to describe the iris flower. Information regarding nomenclature and morphology is beyond the purpose of this publication. What follows is some basic information for the novice gardener to get started (see the *Dictionary of Bulbous Plants* for information about some of the more common types of iris recommended for Tennessee gardens).

Iris will either have bulbs or rhizomes. Regardless of the geophyte, most iris prefer full sun where they thrive. Well-drained but moist soils are important to floral development. If the rhizomes or bulbs get too dry during the summer, flower formation can be inhibited. Many iris are suited to use along streams, ponds or in bogs and marshes.

One of the biggest complaints heard about iris is: "They don't flower like they used to." Several environmental factors will influence flowering; if out of balance, flowering will be reduced. First, when people bought a newly constructed home and planted the yard, the trees were smaller and not casting shade over the iris beds. Check for sunlight. Are the iris beds now shaded? When overcrowded, flowering will be reduced. The bulbs or rhizomes should be dug, divided and replanted, generally about every three years. Division should take place as soon possible after flowering. If you miss the spring division season, wait until the fall when the nights are cooler than in July. Many people wait until August or September to divide iris. A third factor that influences flowering is depth of planting. Iris rhizomes should not be set too deep (follow the recommendations in the *Dictionary of Bulbous Plants*). The irises might not have been planted too deep originally, but over time, the rhizomes get covered by mulch and leaf litter and become buried. With regular division, this will not be a problem.

Planting Summer-Flowering Geophytes

Many of the summer-flowering geophytes are considered to be tender plants. The main exceptions to this rule are the assorted lilies and alliums (ornamental onions). Quite often, all of these plants will be referred to as summer-flowering bulbs; however, very few are true bulbs. Many are tuberous roots, tuberous stems, true tubers, rhizomes and corms. Most of the summer-flowering geophytes require full-sun conditions. The main exception is caladium, which does very well in the shade. Others may benefit from some afternoon shade, which protects them from the hottest sun of the day. Of the summer-flowering geophytes, caladium, canna, dahlia, daylilies and gladiolus are the most popular for the garden.

Caladium:

Caladium has found its greatest usefulness in shade situations. Many of the new cultivars were developed through tissue culture and are being sold as potted plants. They come mostly with pink, red or white variegated foliage. The large leaves can be up to 12 inches in length from end to end.

Caladium tubers can be started indoors in February through April to set in the garden or maintained in large pots for patios or porches. They need six to eight weeks to develop clumps with good foliage. The rough side of the tuber is the top; the bottom is rounded and smooth. Quite often, the central eye is removed to encourage more shoots to develop on the tuber. When planting in pots, just barely cover with growing medium. If setting the tubers directly in the garden, plant 2 inches deep. Caladiums prefer warm growing conditions. Be patient and allow the soil to warm up before planting.

Caladiums need fertilization to encourage good, rapid growth. Avoid high-nitrogen fertilizers, using one with an $N\text{-}P_2O_5\text{-}K_2O$ ratio of 1:2:2. Caladiums require high moisture but well-drained soils. In the fall, lift the tubers before frost and allow them to dry in the sun for a few hours. Store dry at 40 to 45F.

Canna:

Cannas are often misused in flower beds. Many of the tall growing cultivars which attain heights of 4 to 6 feet are often planted in island beds and surrounded by extremely short annuals, thus making the canna appear to be a giant. Properly used, the canna can offer an interesting accent to a landscape. The introduction of dwarf cannas (2 to 3 feet tall) has greatly added to their usefulness. Many of the dwarf cannas can be successfully grown in very large containers for the patio, terrace or entry way. Canna cultivars are available with bronze foliage, making an excellent background to accent low shrubs, annuals or perennials. A few cultivars with variegated foliage offer a striking contrast to the dark green leaves of many landscape shrubs.

Canna rhizomes should be planted in a sunny location. They will do well along streams and ponds or in bogs or shallow water, appreciating the extra moisture. When preparing a bed for cannas, extra organic matter should be incorporated into the soil to help increase water-holding capacity. In areas where the frost-free date is between early April and the end of May, the rhizomes may be planted directly into the flower bed. They should be planted about 1 to 2 inches deep in the bed and about 15 to 20 inches apart, depending upon the ultimate height of the plant. The rhizomes can be started indoors under high-light conditions in large pots and then set outdoors after all danger of frost is passed. To encourage a longer flowering season on the canna, the dead flowers should be removed to prevent seed set.

Cannas are marginally winter hardy in USDA Zone 6 and in most parts of Tennessee, are often treated as hardy and left in the ground to overwinter. Heavy mulch will help insulate them in the winter. In colder regions in the state, such as higher mountain elevations, cannas will need to be dug for winter storage. In autumn, after the first frost blackens the foliage, the stalks should be cut to within 6 to 8 inches of the rhizomes and then lifted from the soil and allowed to partially dry. They should then be sorted and cleaned, discarding any diseased, scarred or insect-infested rhizomes. Store in moist peat moss in a reasonably dry, well-ventilated, dark area at 45 to 50 F.



Canna
Photo courtesy of All-American Selections

Dahlia:

The dahlia is a long-time favorite of the garden. These come in a wide height range from dwarfs, 12 to 18 inches tall, to giants, up to 5 feet tall. They also offer a wide range of flower color and exhibit several different flower types. The main advantage which dahlias offer is continual flower display from midsummer until frost.

The dahlia is planted from either a tuberous root or a seed-propagated plant. Most of the seed-propagated dahlias are dwarf to medium-height cultivars. The tuberous root-propagated cultivars are taller and produce fewer but larger flowers. The seed cultivars are commonly sold as bedding plants during the spring months. The cultivars available as tuberous roots are sold during the winter and spring months either through mail order catalogs or at garden centers. When purchasing dahlia roots, look for a portion of the previous year's stem to still be attached to the clump. The buds for the current season's growth form at the junction



Dahlia

of the roots and the stem. Both the seed-propagated cultivars and the tuberous roots need to be planted in an area where they will receive at least six hours of sun each day and are shaded from the hot afternoon sun. When planting the seed-propagated plants, set them in the ground at the same depth they were in the bedding plant containers. On the other hand, the tuberous roots are planted 4 to 6 inches deep with the roots laid on their side. The tall-growing cultivars (those greater than 3 feet) should be staked at planting. The stakes should be driven about 18 inches into the ground (12 inches below the depth at which the tuberous roots were planted).

To encourage branching of the plant produced from the tuberous roots, the main stem is pruned (pinched) to remove the terminal growing shoot when three sets of leaves are developed. Plants are given a second pinch when the resulting new growth has three sets of leaves. Mulch the bed to a depth of 3 to 4 inches to keep the roots moist and cool. Remove all dead flowers to encourage continual bloom and prevent seed set.

Dahlias cannot survive freezing winters. After the first light frost when there is some damage to the foliage, the roots should be dug and cleaned. After cleaning, any diseased, scarred or insect infested roots should be discarded. The roots are then cut into growing sections for next season. Keep a portion of the stem on each root clump. The clumps are stored in moist peat moss, sawdust, vermiculite or perlite at a temperature of 35 to 40 F through the winter. Roots should be checked periodically to make sure they are not shriveled from water loss. If roots shrivel, sprouting will be adversely affected.

Gladiolus:

The gladiolus is a popular "summer-flowering bulb" that is really a corm. The corms are sized based on diameter. Large corms ($1\frac{1}{4}$ inches in diameter or greater) are the most expensive and are commonly used for commercial production of cut gladiolus. The medium-size corms, $\frac{3}{4}$ to $1\frac{1}{4}$ inches in diameter, are commonly used for gardens.

Classes of gladiolus based upon flower size are:

1. giants with florets greater than $5\frac{1}{2}$ inches,
2. large with florets $4\frac{1}{2}$ to $5\frac{1}{2}$ inches,
3. medium with florets $3\frac{1}{2}$ to $4\frac{1}{2}$ inches,
4. small with florets $2\frac{1}{2}$ to $3\frac{1}{2}$ inches and
5. mini with florets less than $2\frac{1}{2}$ inches.

The giant and large floret types are considered too large for the average garden and are normally grown by gladi-



Gladiolus

olus fanciers or those growing gladiolus for flower show competition.

Since the gladiolus will only produce one flowering stem from each corm, start planting in the early spring in successive plantings at two-week intervals, and ending no later than 60 days prior to frost. This will give continual flowers in the garden from about the middle of summer until frost. At planting, be sure to stake tall cultivars and support flower stalks to prevent toppling. Drive the stakes into the ground at planting, taking care to avoid damaging the corms.

Since the gladiolus is a tender corm, it will need to be dug in autumn prior to frost. Dig the corms on a bright sunny day, which will be good for accelerating the drying process. The stalk is cut flush with the corm. The corms are dried outdoors during the day and moved indoors to an area that is about 80 F and well-ventilated. When the old corm separates easily from the newly produced corm (this will take about one to two weeks before separation occurs), gently pry them apart and discard the old corm. Sort and discard any diseased or scarred corms, and then dry at 80 F for one more week. Once cured, the corms should be stored in a well-ventilated area at 40 F through the winter.

Maintenance of Geophytes

For those hardy geophytes, there are a few maintenance practices to encourage continued vigor and health of the storage structures and maintain floral display: fertilization, deadheading and division.

Use a balanced fertilizer with a N-P_2O_5-K_2O ratio of 1:3:1 or 1:3:2. Bonemeal is a good organic fertilizer for bulbs, since it has the desired ratio of low nitrogen to high phosphorus. It is important to use a low-nitrogen fertilizer whenever bulbous plants are being fertilized. High N will result in bulb decay. Follow the recommended rates on the package. Fertilizer can be applied when the plants are flowering and the roots are actively growing. Fertilizer is also applied in the fall when roots resume growth. Even though the above-ground portion of the plant is dead, the below-ground portion is still actively growing and developing. These below-ground plants still need nutrients for growth and development.

Many bulbs set seed very easily. Once the flowers are spent, cut the flower stalks off as close to the ground as possible without removing the foliage. Deadheading or flower removal is important to allow all nutrients and food to be channeled into the developing storage structures.

Eventually a time will come to divide, clean, sort and replant the geophytes. The main indicators are reduced vigor, reduction in the number of flowers and reduction in the size of foliage and flowers. The length of time between divisions will vary with the plant species and the desires of the gardener. Some people will dig and divide bulbs on a regular basis; others will let nature take its course and divide only when it is absolutely necessary.

Prior to digging the spring-flowering geophytes, the foliage should be allowed to die back naturally. At this point, the bulb should be tan to brown, indicating it is mature. It can be lifted and the remains of dead foliage removed to prevent harboring any disease and insects. All plant material that shows signs of disease, insect or mechanical damage should be destroyed. Also, any undersized bulbs should be discarded, for they will not produce a flower the next year. Once sorted and cleaned, bulbs are replanted into prepared beds.

The summer-flowering geophytes are divided, sorted and inspected normally after they finish flowering. Typically this is done in August through mid-September for the iris so reestablishment can occur prior to frost. For the lily, the bulbs are dug after the plants have flowered. The stems do not have to die back. Commonly, the lily bulb is lifted in very late summer or early fall (late August through September).

Table 1. Cold Storage Periods Needed to Force Bulbs Indoors

Plant	Cold storage period (weeks[1])	Forcing time (days[2])
Tulips	15 to 20	18 to 20
Hyacinths	10 to 20	18 to 20
Daffodils	13 to 20	8 to 21
Minor bulbs	14 to 17	5 to 10

[1] Range indicates minimum and maximum number of weeks. If stored longer, it will be difficult to prevent growth while in storage.

[2] The longer the bulbs are stored, the less time it will take for them to flower.

Forcing Spring-Flowering Geophytes in the Home

It is possible to force spring bulbs to flower out of their normal season. It just takes some pots, growing media and refrigerator space (do not place potted plants in the same refrigerator as you store household foodstuffs). Tulips, daffodils, hyacinths, crocus, grape hyacinths and several other spring-flowering bulbs require approximately 12 to 16 weeks of cold storage at about 33 to 40 F to satisfy the dormancy-breaking requirement. Exposure to this period of cold temperature causes many unseen changes to take place in the bulbs and corms that allow the plants to grow and flower.

Bulb pans or azalea pots are preferred for forcing bulbs indoors. Bulb pans are very shallow pots; the depth is equal to half the diameter. Azalea pots are deeper, with the depth equal to three-quarters the pot diameter. Other containers that are about twice as deep as the height of the bulbs and that have drainage holes can also be used. Place a layer of growing media in the pot. Set bulbs in the pot so the bulbs are touching each other and the tips are just above the top of the pot. Finish filling the pot with growing media and allow about inch of head space for watering. To make sure that the growing media has filled in around the bulbs, firmly tap the pot on the table top to settle the media. Add more media if needed. Add a pot label with the type of bulb and cultivar name. Water well, allow to drain and then place in a refrigerator. You should be able to get from five to seven tulip bulbs or two or three double-nosed daffodil or single-nosed hyacinth bulbs in a 6-inch diameter pot.

Try mixing bulbs in a pot to have a spring garden. Add tulips, hyacinths and/or daffodils together in a large 8- or 10-inch bulb pan. Partially cover the bulbs with growing media, and then place some of the minor bulbs such as crocus, grape hyacinth, squills or bulbous iris on top of the growing media and in among the other bulbs. Finish filling the container with growing media. Water and place in the refrigerator. Check the pots periodically to make sure they do not dry out.

When planting tulips for indoor forcing, remove the dry outer tunic. If the tunic is not removed, the leaves may not be able to grow through it, since there is not enough weight from the growing media to hold the tunic in place. The tunic of daffodils, crocus, hyacinths and other bulbs and corms does not need to be removed. Also, you will notice tulips have a flat side to the bulb. This side of the bulb should be placed facing the outside edge of the pot. The first leaf that emerges from the tulip bulb will come from this side of the bulb. The leaf will then hang over the edge of the pot rather than get clustered in the center.

After the necessary cold-storage period (see Table 1 for some guidelines), bring the pots into a bright location in a room that is around 60 to 65 F. At this point, you should see roots coming out of the drainage holes on the pot. Water well and within a few days you will begin to see signs of growth.

Forcing Tender Geophytes in the Home

A few of the summer- and fall-flowering geophytes are not winter hardy and can be grown in pots for flowering indoors from December through March, depending on the plant. Plants that are commonly grown in pots are amaryllis (*Hippeastrum*), caladium, nerine and calla lily (*Zantedeschia*). Following the guidelines for amaryllis will work for most other tender geophytes.

Amaryllis

Amaryllis bulbs are generally available at garden stores by late November. Many mail order catalogs also offer amaryllis bulbs. The amaryllis bulb is fairly large (up to 10 inches in circumference). Use a 6- or 8-inch clay bulb or an azalea pot; the weight of the clay pot will help prevent the bulb from toppling over when in flower. Place enough growing media in the pot so at least 1/2 to 1/3 of the bulb remains above the growing media surface. Place the bulb on the surface, taking care not to damage any roots that might have begun to grow. Fill in with additional growing media to leave about 1/2 inch of headspace for watering. Water at planting but then sparingly until sprouting occurs. Keep the plant at about 60 to 65 F for two weeks to allow rooting. After rooting, place in a well-lighted area at about 70 to 75 F until bloom. Growth should take two to eight weeks. Once sprouted, water regularly to keep the growing media evenly moist.

Once the flowers have faded, remove the individual flowers but leave the flower stalk (this is green and will also produce carbohydrates to increase the size of the bulb). After the stalk becomes shriveled and yellow, it can be removed. After flowering, start fertilizing once a month using any houseplant fertilizer following label directions. A liquid fertilizer is best, as it can be applied when you water the plant. Make sure the plant is well-watered and fertilized throughout the summer growing season to rebuild the bulb. Once the danger of frost is past, the potted bulb can be set outside in full sun for the summer. Either just set the pot out, sink it into the ground or knock the bulb out of the pot and plant it directly into the ground. In the fall before there is a frost, bring the pot back in or lift the bulbs from the garden and repot. Store in a cool (55F), dark place for at least eight weeks and stop watering. After the resting period, cut off any foliage that remains and move the pot into light and warm (70 to 75 F) temperatures. Keep the soil almost dry until new growth begins in two to eight weeks to start the flowering cycle over again.

Dictionary of Bulbous Plants

Plant name and structure	Time to Plant[1]	Planting depth (inches)	Flowering season[1]	U.S.D.A. Winter Hardiness Zones	Plant height[2]
Acidanthera bicolor (syn. *Gladiolus callianthus*), acidanthera, corm					
May be grown in containers. Dig and store like the gladiolus corm.	Ma	2 to 3	Jy - S	9 & 10	M
Allium species, ornamental onions, tunicate bulb					
Height range of 6" (*A. oreophilum*) to 3' (*A. giganteum*). Taller alliums need to be planted deeper than 3". Tall alliums also make good cut flowers. *A. christophii* is shorter than giant onion and has the largest flowers: large spheres up to 12 inches in diameter.					
A. christophii	S	3	Ma - Ju	3 to 8	M
A. giganteum, giant onion	S	6	Ju	5 to 8	T
A. moly, yellow onion	S	3	Ju - Jy	3 to 8	L
A. oreophilum	S	3	Ma - Jy	4 to 8	L
A. sphaerocephalum, drumstick allium	S	3	Ma - Jy	5 to 8	M
Anemone blanda, Grecian windflowers, tuber					
Soak tubers overnight before planting. Hardy while many other anemones are not. Very early spring flowers. Good for woodland gardens	S	2	F - Ap	5 to 9	L
Anemone coronaria, windflower, tuber					
Soak tubers overnight before planting. Not as hardy or heat tolerant as other anemones. Use as a potted plant or cut flower. Store in dry peat moss at 50 to 55F	Ap, Ma	2	Ma - Ju	6 to 9	M
Belamcanda chinensis, blackberry lily, pachymorphic rhizome					
If faded flowers are not removed, black seed form which attract birds. This has lead to naturalization in the central United States. True native to the Orient.	S	1 to 2	Jy - S	5 to 8	T

[1]January, J; February, F; March, M; April, Ap; May, Ma; June, Ju; July, Jy; August, Au; September, S; October, O; November, N; December, D.
[2]L=less than 1 foot tall; M=1 to 2 1/2 feet tall; T=3 to 8 feet tall.

Plant name and structure	Time to Plant[1]	Planting depth (inches)	Flowering season[1]	U.S.D.A. Winter Hardiness Zones	Plant height[2]
Caladium hortulanum (Syn. *C. bicolor*), caladium, tuber					
Started indoors in pots since tubers are not hardy. Need to dig in the fall before frost and store in dry peat moss at 40 to 45F.	F	2 to 3		8 to 11	M
Camassia quamash, camass, tunicate bulb					
Native American plant. Tolerates damp meadows, bogs and pond edges as well as heavy clay soils. Grasslike foliage with racemes of blue narrow bell-shaped flowers. Rarely needs division.	S, O	4	Ma - Ju	4 to 8	M
Canna generalis, canna, pachymorphic rhizome					
Tolerates damp meadows, bogs and pond edges. Many new dwarf cultivars and cultivars with variegated foliage are being introduced. *Zone 6 and north need to dig in the fall and store in moist peat at 40 to 50 F.*	Ma	2 to 3	Jy - O	7 to 11	T
Chionodoxa luciliae, glory-of-the-snow, tunicate bulb					
Best in mass plantings since plants are extremely small. Good for naturalizing. No need to dig and divide.	S, O	4	Ap - Ma	3 to 8	L
Colchicum autumnale, meadow saffron, autumn crocus, corm					
Foliage emerges in the spring and dies by the end of July, then flowers in the fall. Ants feed on the flowers and spread the seeds. Suited to rock gardens.	Au	8	S - N	3 to 9	L
Convallaria majalis, lily-of-the-valley, leptomorphic rhizome					
Spreads rapidly by rhizomes, making it an excellent ground cover for the shade. Flowers are extremely fragrant and can be used as a cut flower. Unripe fruit are toxic if eaten.	Ap	1	Ma - Ju	2 to 7	L

[1]January, J; February, F; March, M; April, Ap; May, Ma; June, Ju; July, Jy; August, Au; September, S; October, O; November, N; December, D.
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Plant name and structure	Time to Plant[1]	Planting depth (inches)	Flowering season[1]	U.S.D.A. Winter Hardiness Zones	Plant height[2]
Crocosmia x crocosmiiflora, montbretia, corm					
Full sun in moist and well-drained soil. Excellent cut flower. Divide every two to three years. At higher mountain elevations, may need to dig in the fall and store same as gladiolus.	Ma	2 to 3	Jy - S	6 to 10	T
Crocus species and hybrids, crocus, corm					
Many crocus are hybrids of several species. Some crocus species are fall-flowering. *Crocus* hybrids *C. speciosus*	 S Ma	 3 to 4 3 to 4	 Ap S - O	 4 to 10 4 to 10	 L L
Dahlia hybrids, garden dahlia, tuberous root					
Treated as an annual. Can be used as cut flower. The tuberous roots are dug after a light frost and stored in moist peat moss at 35 to 40 F.	Ap, Ma	6	Ju - O	8 to 10	M T
Eranthis hyemalis, winter aconite, tuberous root					
Soak dried tuberous roots before planting. Prefers rich, organic soils in partial shade. Slow to establish. Blooms appear on 3" stems and come before the foliage. Increases rapidly.	O	3	J - M	4 to 8	L
Erythronium albidum, white dog's tooth violet; *E. americanum*, trout lily; *E. californicum*, fawn lily; E. *dens-canis*, dog's tooth violet, corm					
Several species are native to U.S. All do best in moist, highly organic soils in partial shade. Foliage tends to be dark green and mottled silvery. **Do not dig from the wild.** E. dens-canis is the easiest to establish. No need to divide.	S	3	M - Ma	5 to 10	L

[1]January, J; February, F; March, M; April, Ap; May, Ma; June, Ju; July, Jy; August, Au; September, S; October, O; November, N; December, D.
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Plant name and structure	Time to Plant[1]	Planting depth (inches)	Flowering season[1]	U.S.D.A. Winter Hardiness Zones	Plant height[2]
Fritillaria species, tunicate bulb					
Unusual striking flowers. *F. meleagris* will naturalize and multiply in milder zones. Bulbs have foul odor that repels pests. Need rich, organic soils in semi-shade. *F. imperialis*, crown imperial *F. meleagris*, checkered lily, guinea hen flower	 S S	 6 3	 Ma M - A	 4 to 7 4 to 8	 T L
Galanthus nivalis, snowdrop, tunicate bulb					
Early sign of spring. Tolerant of moist soils. Excellent for naturalization under trees and shrubs. Takes shade.	O	3	Ap	2 to 9	L
Gladiolus hybrids, gladiolus, corm					
Treated as an annual; dig when foliage dies; store in mesh bags at 40 F in an area with good air circulation. Flowers are borne in decorative spikes; used as a cut flower.	Ma	4 to 6	Jy - S	9 & 10	M T
Hemerocallis hybrids, daylily, tuberous root					
Numerous colors, heights and seasons of bloom; singles and doubles, reflowering types.	Ma - S	6	Ju - Au	4 to 9	M T
Hippeastrum hybrids, amaryllis, tunicate bulb					
Plant in shallow pots with half of the bulb above the growing media. Pots may be set outdoors during the summer.	S - D	---	D - F	9 & 10	T
Hyacinthoides hispanicus, (Syn. *Endymion hispanicus*, *Scilla campanulata*), Spanish bluebells; *H. non-scriptus* (Syn. *Endymion non-scriptus*), wood hyacinth, tunicate bulb					
Good for borders, rock gardens or naturalizing. Adapts to wide range of soils. Very hardy. Good cut flower.	O	3 to 4	Ma - Ju	3 to 10	M

[1]January, J; February, F; March, M; April, Ap; May, Ma; June, Ju; July, Jy; August, Au; September, S; October, O; November, N; December, D.
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Plant name and structure	Time to Plant[1]	Planting depth (inches)	Flowering season[1]	U.S.D.A. Winter Hardiness Zones	Plant height[2]
Hyacinthus orientalis, hyacinth,tunicate bulb					
Very sweet fragrance. Best when massed in beds or borders. Bulbs tend to deteriorate after one or two years especially in poorly drained soils. Full sun. About one in 12 people may develop a skin rash if the sap from the bulbs or stems contacts exposed skin.	O	6 to 8	Ap	4 to 8	L
Ipheion uniflorum, spring starflower, triteleia, tunicate bulb					
Delicate blue flower with yellow centers. Foliage emerges in fall and is persistent through the winter. Great for naturalizing and rock gardens. Does best when crowded.	S,O	2 to 3	Ap	5 to 10	L
Iris hybrids, bearded iris, pachymorphic rhizome					
Numerous cultivars available. Can be used as a cut flower. These need to be divided about every fourth year. Will get iris borers in the rhizomes.	Au, S	1 to 2	Ma - Ju	3 to 10	M
Iris fulva, Louisiana hybrid iris, pachymorphic rhizome					
Robust plants from marsh and bogs in the central United States.	S	1 to 2	Ju -Jy	5 to 10	T
Iris ensata and *I. laevigata*, Japanese iris, pachymorphic rhizome					
Do not need to divide as often as bearded iris. Fewer cultivars to choose from. Use as aquatic or "marginal" (along waterways) plants. Can be used as a cut flower.	S	1	Ju - Jy	5 to 10	T
Iris reticulata, netted iris, tunicate bulb					
Early flowering iris. No need to disturb planting for several years, smaller plants, about 2 1/2 inches tall. Great for rock gardens.	S	4	M	3-9	L

[1]January, J; February, F; March, M; April, Ap; May, Ma; June, Ju; July, Jy; August, Au; September, S; October, O; November, N; December, D.
[2]L=less than 1 foot tall; M=1 to 2 1/2 feet tall; T=3 to 8 feet tall.

Plant name and structure	Time to Plant[1]	Planting depth (inches)	Flowering season[1]	U.S.D.A. Winter Hardiness Zones	Plant height[2]
Iris sibirica x I. sanguinea, Siberian iris, pachymorphic rhizome					
Do not need to be frequently divided. Can be used as a cut flower.	S	1	Ju	3 to 8	T
Leucojum vernum, spring snowflake, tunicate bulb					
Will grow in damp locations. Naturalizes well.	S,O	4	M - Ap	4 to 9	L
Lilium species and hybrids, lily, scaly bulbs					
With nine horticultural divisions, there are numerous species and hybrid cultivars, various colors, flower forms and plant heights. Make good cut flowers.	S, O	4 to 10	Ju - Au	4 to 8	T
Liriope species, lily turf, leptomorphic rhizome					
Flowers on spikes above grass-like foliage that turns yellow-green to tan through the winter. Tolerant of dry soils if in the shade. *L. spicata* tolerates deeper shade and moister soils. *L. spicata*, creeping lily-turf *L. muscari*, big blue lily-turf	 Ma - S Ma - S	 2 2	 Jy -Au Jy -Au	 4 to 10 5 to 10	 L L
Lycoris squamigera, naked lady, resurrection lily, autumn amaryllis, magic-lily-of-Japan, miracle lily, *L. radiata*, spider lily, red spider lily, tunicate bulb					
Foliage emerges early in the spring with the daffodils then dies back. Flowers in late summer. Persistent and naturalizes well. Partial shade. No need to divide.	Ju	6	Au	4 to 9	M
Muscari armeniacum, grape hyacinth, *M. azureum*, *M. botryoides*, Italian grape hyacinth, tunicate bulb					
Most common of the small bulbs grown in gardens. Naturalizes well. Several cultivars available: white, blue and double flowers.	S, O	3	Ma - Ju	4 to 9	L

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[2]L=less than 1 foot tall; M=1 to 2 1/2 feet tall; T=3 to 8 feet tall.

Plant name and structure	Time to Plant[1]	Planting depth (inches)	Flowering season[1]	U.S.D.A. Winter Hardiness Zones	Plant height[2]
Narcissus species and cultivars, daffodils, jonquils, poet's narcissus and narcissus, tunicate bulbs					
The 12 classes of *Narcissus* identified by the Royal Horticultural Society and the American Daffodil Society are based on corona and perianth size and color as well as species of *Narcissus*. Note: freshly cut daffodils should be held in separate container for a few hours since they exude a slimy substance which can result in premature death of other cut flowers like tulips or anemones.	S	8	Ap - Ma	3 to 8	L M
Nerine bowdenii, nerine, tunicate bulb					
Flowers in the fall with foliage emerging soon after. Foliage persists through winter and dies back in the spring. Marginally hardy in Zone 6.	Ju, Jy	1 to 2	Au - S	7 to 10	M
Ornithogalum umbellatum, star-of-Bethlehem, tunicate bulb					
Extemely hardy and easy to grow. White flowers with green stripe when in bud. Good for naturalizing; multiplies rapidly at the bulb and from seeds.	S, O	2 to 3	Ap - Ma	4 to 10	M
Scilla siberica, Siberian squill, tunicate bulb					
Good for beds, borders or naturalizing. Will spread from seeds.	O	3	Ap - Ma	1 to 9	L
Sternbergia lutea, fall crocus, winter daffodil, tunicate bulb					
Good for naturalizing. Mulch in Zone 6 to increase chances of winter survival. Marginally hardy in Zone 6.	Ju, Jy	4	S - O	7 to 10	L
Trillium species, trillium, wood lily, wake robin, leptomorphic rhizome					
Native wildflower adapted to moist, organic soils and shady gardens. **Do not dig from the wild.**	O	2 to 3	Ap - Ju	4 to 10	M

[1]January, J; February, F; March, M; April, Ap; May, Ma; June, Ju; July, Jy; August, Au; September, S; October, O; November, N; December, D.
[2]L=less than 1 foot tall; M=1 to 2 1/2 feet tall; T=3 to 8 feet tall.

Plant name and structure	Time to **Plant**[1]	Planting **depth (inches)**	Flowering **season**[1]	U.S.D.A. **Winter Hardiness Zones**	Plant **height**[2]
Tulipa species and hybrids, tulip, tunicate bulb					
The 15 classes are based on flowering time, flower shape and species. Short-lived bulb; replant every two or three years depending upon the quality of display desired. Make good cut flowers.	S, O	8	Ma - Ju	3 to 8	L M
Zantedeschia species, calla lily, pachymorphic rhizome					
Started indoors in 6-inch pots, then set into the garden. Fertilize frequently. Make good cut flowers. Should be dug and stored as cannas or in pots. Flowering may stall in the heat of summer.	M, Ap	3 to 4	Ju - Jy	9 & 10	M T
Zephyranthes species, zephyr flower, rain lily, tunicate bulb					
Flower mid-summer through fall depending upon species. Can be grown in pots (handle similar to amaryllis, *Hippeastrum*). Marginally hardy in Zone 6.	S, O	4	Jy - O	7 to 10	L

[1]January, J; February, F; March, M; April, Ap; May, Ma; June, Ju; July, Jy; August, Au; September, S; October, O; November, N; December, D.
[2]L=less than 1 foot tall; M=1 to 2 1/2 feet tall; T=3 to 8 feet tall.

The Bulb Selector

For Moist Situations

- Caladium
- Camassia
- Canna
- Convallaria
- Erythronium
- Leucojum
- Zantedeschia

For Light to Partial Shade

- Allium
- Anemone (woodland species)
- Caladium
- Camassia
- Eranthus
- Erythronium
- Fritillaria
- Galanthus
- Hyacinthoides
- Ipheion
- Leucojum
- Lycoris
- Muscari
- Ornithogalum
- Scilla
- Zantedeschia

For Woodland

- Allium
- Camassia
- Convallaria
- Erythronium
- Galanthus
- Hyacinthoides
- Iphion
- Leucojum
- Scilla

For the Mixed Border

- Acidanthera
- Allium
- Anemone
- Belamcanda
- Camassia
- Canna
- Crocosmia
- Dahlia
- Fritillaria
- Gladiolus
- Hyacinthus
- Hyacinthoides
- Iris
- Leucojum
- Lilium
- Lycoris
- Muscari
- Narcissus
- Ornithogalum
- Scilla
- Tulipa
- Zephyranthes

For Feature Plantings and Landscape Groups

- Acidanthera
- Anemone
- Belamcanda
- Caladium
- Camassia
- Canna
- Crocosmia
- Crocus
- Dahlia
- Fritillaria
- Gladiolus
- Hippeastrum
- Hyacinthus
- Iris
- Lilium
- Lycoris
- Narcissus
- Tulipa

For Naturalizing

- Allium
- Camassia
- Chionodoxa
- Colchicum
- Convallaria
- Crocus
- Eranthus
- Erythronium
- Fritillaria meleagris
- Galanthus
- Hyacinthoides
- Leucojum
- Lilium
- Lycoris
- Muscari
- Narcissus
- Ornithogalum
- Scilla
- Tulipa

For the Rock Gardens

- Allium moly
- Anemone blanda
- Camassia
- Chionodoxa
- Colchicum
- Crocus
- Eranthus
- Erythronium
- Fritillaria meleagris
- Galanthus
- Ipheion
- Leucojum
- Lilium
- Muscari
- Narcissus
- Scilla
- Tulipa
- Zephyranthes

For Container Gardening

- Caladium
- Hippeastrum
- Nerine
- Zandeschia

For Fragrance

- Acidanthera
- Convallaria
- Hyacinthus
- Ipheion
- Iris
- Lilium
- Narcissus (Poet's and jonquil cultivars)
- Ornithogalum

For Cut Flowers

- Allium
- Anemone
- Belamcanda
- Caladium*
- Canna*
- Convallaria
- Crocosmia
- Dahlia
- Gladiolus
- Hyacinthus
- Lilium
- Lycoris
- Muscari
- Narcissus
- Nerine
- Ornithogalum
- Tulipa
- Zantedeschia*

*Indicates decorative foliage

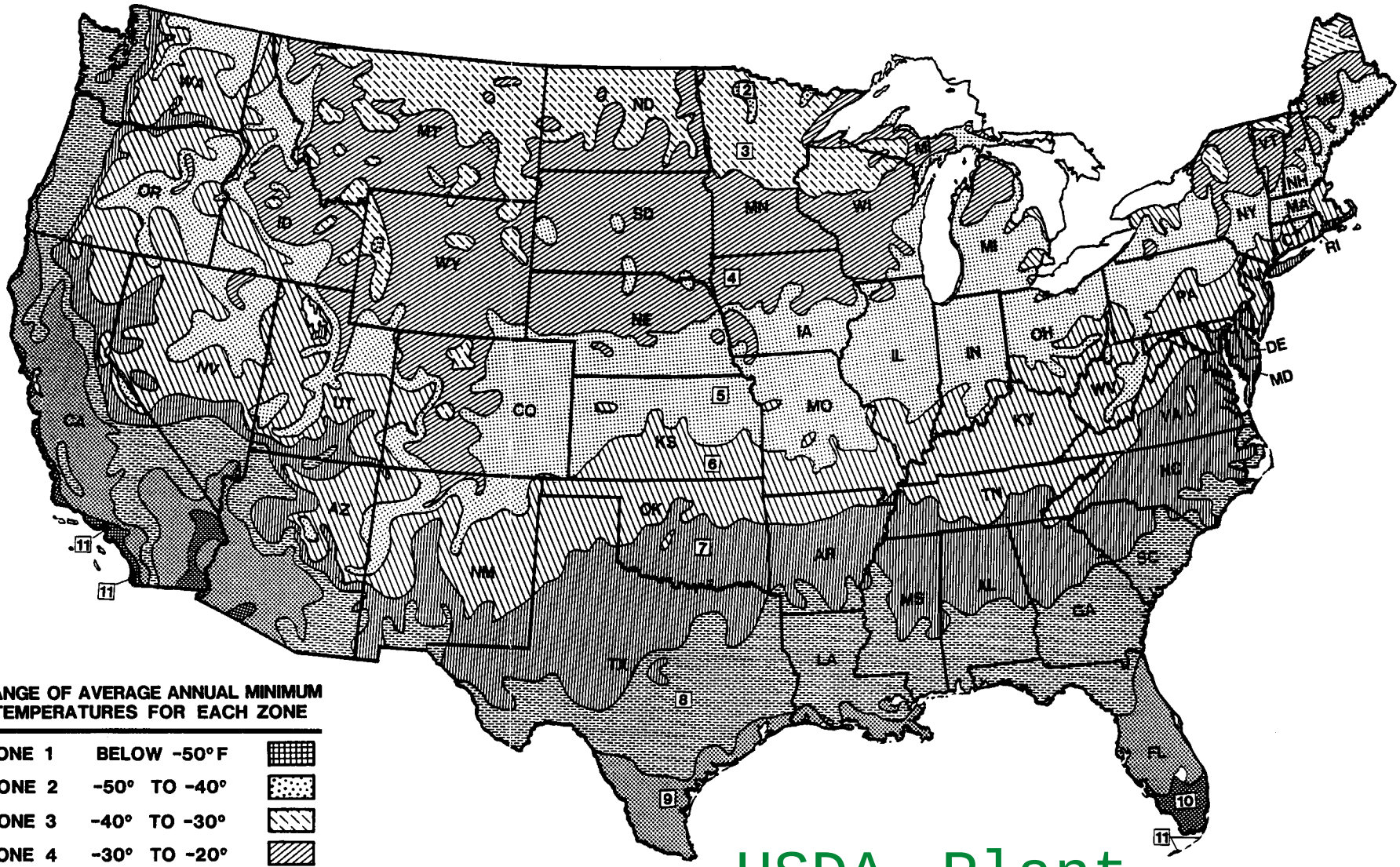
Mail Order Sources

Several mail order catalogs that supply seeds and plants also offer bulb catalogs. Firms specializing in bulbs and bulbous plants include the following. Other firms also specialize in bulbs; no endorsement is intended nor is any criticism implied of similar firms not mentioned.

McClure & Zimmerman
108 W. Winnebago
P.O. Box 368
Friesland, WI 53935
Phone:920/326-4220
Fax:800/692-5864

The Daffodil Mart
7463 Heath Trail
Gloucester, VA 23061
Phone:800/ALL-BULB
800/255-2858
Fax:800/420-2852

Van Engelem, Inc.
23 Tulip Dr.
Bantam, CT 06750
Phone:860/567-8734
Fax:860/567-5323



RANGE OF AVERAGE ANNUAL MINIMUM TEMPERATURES FOR EACH ZONE

ZONE 1	BELOW -50° F	
ZONE 2	-50° TO -40°	
ZONE 3	-40° TO -30°	
ZONE 4	-30° TO -20°	
ZONE 5	-20° TO -10°	
ZONE 6	-10° TO 0°	
ZONE 7	0° TO 10°	
ZONE 8	10° TO 20°	
ZONE 9	20° TO 30°	
ZONE 10	30° TO 40°	
ZONE 11	ABOVE 40°	

USDA Plant Hardiness Zone Map



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