

Cultivars and their cold periods

A list of the leading cultivars for cut flower production and their required cold periods: the number of weeks (when planted at 9°C) for the various forcing periods.

CULTIVAR	GROUP	BEGIN FORCING BEFORE 17 DEC.	BEGIN FORCING FROM 17 DEC. TO 17 JAN.	BEGIN FORCING FROM 17 JAN. TO 17 FEB.	BEGIN FORCING FROM 17 FEB. TO 17 MARCH
Las Vegas	Bicolor	-	18	17	16
Delnashaugh	Double	-	-	-	17
Dick Wilden	Double	-	16	16	16
Sir Win. Churchill	Double	-	-	16	16
Tahiti	Double	-	-	17	16
Carlton	Large-cupped	16	15	14	14
Fortune	Large-cupped	15	15	14	-
Gigantic Star	Large-cupped	16	15	14	14
Ice Follies	Large-cupped	16	15	15	14
Johann Strauss	Large-cupped	17	17	16	16
Pink Charm	Large-cupped	-	-	15	15
Prof. Einstein	Large-cupped	17	16	16	15
Salome	Large-cupped	-	-	18	18
Martinette	Jonquilla	-	-	17	17
Barrett Browning	Small-cupped	15	15	14	14
Cragford	Tazetta	15	14	14	14
Geranium	Tazetta	-	-	18	17
Dutch Master	Trumpet (yellow)	17	17	16	16
Golden Harvest	Trumpet (yellow)	15	15	14	14
Marieke	Trumpet (yellow)	18	18	17	17
Standard Value	Trumpet (yellow)	-	-	16	16

- = less suitable or totally unsuitable for this forcing period



Good preparation: the basis for success

A forcing schedule makes it easier to plan

A forcing schedule can be drawn up based on duration of the recommended cold periods. To plan a harvest on 20 February, for example, the lengths of the cold period and the forcing period have to be subtracted from that date to arrive at the planting date for uncooled bulbs (or the start of the cold period for cooled bulbs). The length of the forcing period depends on the forcing method, the time of year, the cultivar being used, and the greenhouse climate. If the forcing period lasts 3 weeks and the cold period for that cultivar is 16 weeks, 19 weeks will have to be subtracted from the planned flowering date to arrive at the time when cooling or planting at low temperatures should be started.

SAMPLE FORCING SCHEDULE

- greenhouse period until the end of harvest: 3 weeks
- cold period required by the cultivar: 16 weeks
- put daffodils in rooting room or plant them: 19 weeks before the desired flowering period

Greenhouse temperature and watering

Daffodils do not need much light, so most greenhouses are suitable for forcing them. Should there not be enough light, however, the plants can become quite tall and limp. As spring approaches, some shading can help prevent excessively high temperatures that would result in more rapid flowering. Forcing in boxes is often done on benches to improve the efficiency of harvesting, but the boxes can also be placed on the ground. Large boxes up to 1 to 1.5 m² are positioned by tractor or forklift onto pallets or a tube frame. Watering can be applied in various ways including from overhead. Applying less water results in shorter plants. Humidity must be higher (up to around 90%) for daffodils than for tulips, so insulating the greenhouse with plastic sheeting would be beneficial. However, try to prevent plants from falling over. Forcing at relatively low temperatures (preferably 12-16°C) will yield the best results. This is especially important for double-flowering and red-cupped varieties. The length of the greenhouse period depends on the forcing method, cultivar, shoot length at the time of housing, the time of year in which forcing is done and the greenhouse climate, and will usually last two to three weeks.

Harvesting with care to maintain good quality

Greenhouses can be used to force bulbs that have been planted either in boxes or in the border soil. Either method always involves harvesting the leaves along with the flowers. This is why it is important to obtain daffodils with long enough 'collars' below the leaves since this leaf collar holds the leaves together.

Harvest and post-harvest treatment



Daffodils that have been forced into flower or grown in the field specifically for cut flower production are always harvested with the leaves. Only when daffodils are being harvested as a by-product of bulb production are they harvested without the leaves. This is done in order to allow the bulbs to grow larger. The most beautiful bunches are obtained by cutting the stems just above the bulb and including the collar so that the leaves are held together.

Daffodils planted deeply in the soil are more difficult to harvest and often produce very long bunches. Some plant them deeply to prevent frost damage. Daffodils are ready for harvest when their buds have just started to open. This is important to ensure when harvesting daffodils produced by early forcing because otherwise they may not open properly. When forced into flower from February onward, it is possible to harvest them just before the buds open. Double-flowering daffodils have much larger buds and must always be harvested once their spathes have split. (See the photos of maturity stages according to the Association of Dutch Flower Auctions.) Harvested daffodils can be stored in water and kept in refrigerated storage at around 2°C. In the UK daffodil flowers are usually stored dry – no water, even in retail outlets.



Immediate planting prevents problems

Problems can be prevented by a careful choice of material, proper scheduling, proper planting conditions and immediate planting. Here are the leading diseases and how to deal with them.

CAUSE	SYMPTOMS	PREVENTION/CONTROL
Botrytis species, Stagonospora (smoulder, fungus)	 Dark brown leaf tips. The noses and outer scales of the bulbs display rotten spots often accompanied by small sclerotia.	After receipt of the bulbs, either plant them quickly or remove them from their packaging and store properly under dry conditions. The bulbs of susceptible cultivars (including Tête-à-Tête) should be dipped in a suitable fungicide.
Fusarium (bulb rot, fungus)	 Plants grow crookedly or fail to emerge at all. Tissue inside the bulb, particularly in the lower part, displays greyish brown rot.	Use pathogen-free, fresh soil. Plant bulbs immediately after delivery. Plant the bulbs at low temperatures: 9°C or lower.
'Spread'	Plant falls over before or during harvest.	Schedule properly and do not force too rapidly. Avoid excessively long cold periods and high greenhouse temperatures. Do not plant too deeply, and ensure enough light during forcing.
Flower bud blasting	Flower buds dry out on the stems above the bulb or inside the bulb.	Make sure that the greenhouse temperature is not too high during early forcing. Prevent frost damage. Keep the soil from becoming too dry and keep the RH from becoming too low.



PRODUCING DAFFODILS FOR CUT FLOWERS

PRACTICAL TIPS FOR

- DECIDING ON THE RIGHT CULTIVAR AND PRODUCTION SCHEDULING
- EFFECTIVELY TREATING BULBS BEFORE STARTING PRODUCTION
- USING THE RIGHT GROWING CONDITIONS FOR CUT FLOWER PRODUCTION
- PREVENTING PROBLEMS DURING PRODUCTION





The right starting material and proper scheduling are important

A daffodil bulb is usually made up of a single round bulb to which one or more offsets are attached, the resulting cluster being known as a double-nosed bulb. When large enough, round bulbs will produce a single shoot with a flower. As a rule, the round bulbs included in double-nosed bulbs will always produce flowers, whereas offsets will produce flowers depending on their size and when they are brought into flower. Bulb sizes depend very much on the kind of cultivar and can vary in circumference from 10/12 to 18/- centimetres. When used for early flowering, the bulbs will produce fewer flowers that will be lighter in weight. It is important to order the bulbs in advance (preferably more than six months ahead of time) so that they can be given the right temperature treatment for the desired flowering period. Bulbs can be ordered as uncooled bulbs that still need to receive their entire cold period, or as bulbs that have been pre-cooled at 9°C for 4 to 10 weeks. In the latter case, the length of this pre-cooled period can be deducted from the length of the required cold period. The forcing of daffodils takes place primarily from December through March, particularly in February and March.

Synchronising temperature treatment to flowering period

After being lifted in July, all daffodil bulbs have to receive a warm period. Bulbs to be used for earliest forcing have to be lifted earlier than this and then sometimes subjected to a special warm period. For many daffodils, flower initiation has already been completed during the lifting period. After this has occurred, the cold period can be started. This can be accomplished by planting them during the autumn

either outside or in the greenhouse where they will be subjected to seasonal cold temperatures. Another option is to plant the bulbs in boxes or trays that will be stored in refrigerated rooting rooms. The desired flowering date determines the time at which the cold period is to be started (earlier for early flowering periods, later for late flowering periods). After the cold period has been completed, forcing can begin. For early forcing, the bulbs will also have been subjected to a period of dry pre-cooling before being planted. This means that they have already received part of their cold period before delivery. Some daffodils in the Tazetta group do not require any cold period (these are not addressed in this manual).

Treatment after receipt

The bulbs will usually be delivered at the time when they can be planted. The cold period can be initiated by planting them at low temperatures. It is not advisable to leave the bulbs in their packaging or to store them in a damp place for very long. If it is impossible to plant the bulbs straightaway, they must be stored in a dry place at temperatures of about 17-20°C and provided with ample air circulation. If the bulbs have already been pre-cooled or if cooling can begin straightaway, a good temperature to start with is around 9°C. If the bulbs are stored under conditions that are too damp, they will start to root prematurely and can then become infected with the diseases *Penicillium* and *Botrytis*. Under conditions that are too warm as well as too damp, the bulbs can also be damaged by *Fusarium* bulb rot. In cases of doubt, consult with your supplier.



Forcing in boxes placed in a plunge bed or refrigerated rooting room

Rooting and providing cold treatment outside

The most commonly used method involves planting daffodil bulbs in larger or smaller boxes and placing them in a plunge bed using the soil at that location. This soil must provide good drainage. Boxes with a slatted wooden bottom ensure that most of the roots will remain inside the container. The bulbs are planted next to each other on top of a layer of soil about 6-7 cm deep and then covered with a layer of sand around 3-5 cm thick. This will result in a sufficiently long 'collar' (a rather narrow sheath formed by the outer leaf at the point where the shoot emerges from the bulb and which surrounds the other leaves and flower stem). Boxes or trays must be 8 to 12 cm deep. Applying a mulch (example: 8 to 12 kg of straw per m²) will be necessary to prevent frost damage and to allow the housing of the bulbs during freezing weather.

The bulbs can be planted once the soil temperature drops below 8-12°C. Planting at higher temperatures involves more risk of diseases such as *Fusarium* bulb rot. In the Netherlands, bulb forcing is often done in large boxes measuring 1 x 1.2 or 1 x 1.5 m. A tractor pulls these boxes from the plunge bed, and a forklift is used to place them on frames or pallets in the greenhouse. After their cold period, properly rooted daffodil bulbs with a shoot length of 5 to 12 cm, can be taken into the greenhouse. If the daffodil bulbs are still in the plunge bed early in the spring, their shoots can become too long, so remove the straw mulch before this can happen. Once the risk of hard frost is over, the boxes can be removed from the plunge bed at which time the layer of soil covering and between the shoots can be removed.



Forcing in the greenhouse border soil and field production

Greenhouse border soil

Instead of planting in boxes that can later be housed, it is also possible to plant the bulbs directly in the greenhouse border soil. Usually, the upper layer of soil is removed and the remaining surface levelled and planted all over with daffodil bulbs. The bulbs may be planted densely (next to one another). The soil removed from the first bed is used to cover the next bed. Bulb noses must be covered with 5 to 6 cm of soil. Too little soil covering the bulbs will produce insufficient collar length; too much soil can result in plants that fall over easily. Before planting, the greenhouse temperature must be reduced to 8-12°C. Afterward, it will have to be kept at about 9°C and possibly dropped to 0°C during the cold period. In the latter case, more time will have to pass before the greenhouse may be heated. Once the bulbs have received their cold period, the greenhouse may be heated or the windows may be closed again so that seasonal heat brings the daffodils into flower. In the Netherlands, production also makes use of mobile greenhouses. After the bulbs have received enough cold provided by natural ambient conditions, a mobile greenhouse is placed over them.

Field production

Many cut daffodils are also harvested in the field as a by-product of standard daffodil bulb production. In this case, the flowers are harvested without the leaves. In bulb-producing regions, the bulbs are usually planted by means of special machinery. When planting specifically for flower production, however, the bulbs can be planted almost touching each other so that the flowers and leaves can be harvested together. Planting is done just as it is when planting in the greenhouse. The major factors determining the flowering period are outdoor temperatures and the cultivars used, but flowering usually occurs from mid-February to mid-April. If very low temperatures are expected, it would be advisable to apply a mulch or a couple of layers of frost-resistant plastic sheeting. Daffodils that have been planted deeply in the soil will display less frost damage but will be harder to harvest from the soil and will often produce excessively long bunches. An effective mulch would be 8 to 12 kg of straw per m² that should be removed once the daffodils emerge. A plastic greenhouse or tunnel can also be used for an earlier harvest.



Proper synchronisation of planting time is important

The planting time depends on various factors:

- **The desired flowering period**
For flowering in December, batches of cultivars especially intended for early forcing will have to be planted well in advance. These are usually pre-cooled bulbs that are planted in September in boxes placed either in a plunge bed or a rooting room. For later flowering, the bulbs can be planted later (see: Cultivars and their cold periods). The bulbs will take at least 6 weeks to root.

- **Soil temperatures**
For earliest forcing, it is possible to plant early (as soon as the end of August) in refrigerated rooting rooms. When planting in the field or in an unheated greenhouse, it would be better to wait until the soil temperature drops to 12°C or lower. Excessively high temperatures increase the risk of diseases. Tazetta daffodils in the Paperwhite Group, however, can be planted at higher soil temperatures (16-18°C). Daffodil bulbs have to be planted in plenty of time before the risk of a hard frost period occurs. Planting at low temperatures (5°C or lower) will result in slower root and shoot development and a delay in forcing. This is why most daffodils are planted between mid-September and mid-November in Western Europe.

Planting density and temperature during the cold period

Daffodils should be planted in an upright position and next to one another so that the stems grow straight up out of the bulbs. The number of bulbs per net m² depends mostly on the bulb size and bulb shape: a rule of thumb is about 25 kg/net m². The best temperature during the cold period is 9°C. If the planted bulbs spend a long time at lower temperatures, the cold period will have to be extended by one to three weeks. Temperatures much higher than 12-13°C involve more risk of diseases; temperatures much lower than 5°C will result in poor development and shorter plants. If bulbs that have been planted and placed in refrigerated rooting rooms display shoots that are too long, the temperature must be lowered temporarily but not any lower than 0°C. Tazetta daffodils in particular are susceptible to frost damage. Daffodils are often stored in the same rooting room with tulips, so the temperature in the rooting room has to be dropped sooner. In theory, this can be done as long as the cold period is long enough. Shoot length should be 5-10 cm. when housing takes place.

BEST TEMPERATURE DURING COLD PERIOD	PERIOD
9°C	(August), September, October
9°C (can be lowered to 7, 5, 2°C as needed)	November, December
9°C (can be lowered to 0°C but not lower)	January, February, March



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