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DAFFODILS

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DEFINITION AND CLASSIFICATION OF THE DAFFODIL GROUP

The name "daffodil" originally referred to the trumpet, short, and medium-trumpet forms of *Narcissus*, but has now come to be coextensive with *Narcissus*. It is so used throughout this circular. The genus *Narcissus* forms a large and important part of the *Amaryllidaceae*, a family which includes in addition such important and well-known ornamental genera as *Amaryllis*, *Galanthus*, *Nerine*, *Clivia*, *Eucharis*, *Vallota*, and *Crinum*. It differs from the lilies in having the floral parts inserted on top of the seed vessel instead of on the stem below it.

The common names applied to the genus and its divisions are rather confusing. The generic name, *Narcissus*, is used as a vernacular and as a scientific name, both properly referring to all the members of all the groups.

The jonquils constitute a small group of rush-leaved forms, derivatives (fig. 1) of *Narcissus jonquilla*. In a florist-trade sense, however, jonquil is often improperly used to designate the trumpets. (Fig. 2.)

Attempts have been made to broaden the use of the word "narcissus," used as a common name, by employing the same form of the

¹ This circular is a revision of and supersedes U. S. Department of Agriculture Bulletin 1270, *The Production of Narcissus Bulbs*.

word for both singular and plural to obviate the awkward Latin and the still more awkward English plural form. The practice, which seems worthy of emulation, has not been generally adopted.

The daffodil has a very characteristic flower set on top of a leafless stem (scape). The stem is attached to the base of the seed vessel (ovary), and superimposed upon the seed vessel is the flower, which consists of a tube inclosing the pistil and stamens and bearing the six perianth segments.

In long-trumpet daffodils (fig. 3), such as King Alfred, it will be seen that the tube is wide and conical, and the perianth segments are attached to it below the middle. The trumpet is as long as the segments, wide flaring, and recurved at the rim. If a flower of a poeticus daffodil, such as *Recurvus* (fig. 4), is examined, the same parts will be seen, but they look quite different. The tube is long and narrow, and the perianth segments are inserted far from the ovary. The trumpet or corona is short, reduced, and flattened. The stamens are inserted on the tube as before, but in two series of three each, one near the throat and the other lower down.

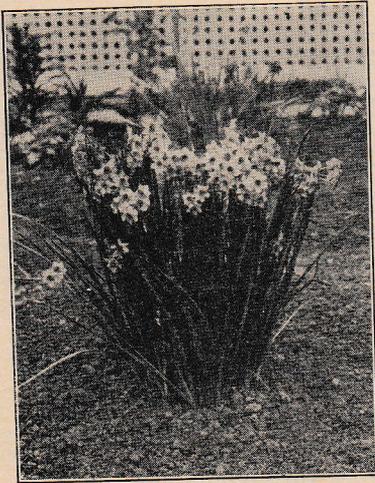


FIGURE 1.—*Narcissus odorus campernellii*, undisturbed in a herbaceous border for five years. Salem, Oreg.

of varieties with all gradations between the mammoth trumpet of King Alfred and the small cups of the poets.

The confusion in the attempted classification of the host of garden hybrids led to the appointment of the daffodil nomenclature committee by the Royal Horticultural Society of London in 1908. This committee published a Classified List of Daffodil Names, which has been three times revised, the last issue being that in 1929 (8).² The report represents a tremendous amount of labor in bringing together and arranging alphabetically nearly all the names that have been given to daffodil varieties. Two lists are published, the first containing about 3,000 names in current use for varieties of daffodils, and the other about 2,000 more which for one reason or another are antiquated.

² Italic numbers in parentheses refer to Literature Cited, p. 73.

The classification is artificial, of course, and has been added to as experience in its use indicated was necessary. The genus is segre-



FIGURE 2.—The large-trumpet daffodils: Upper, left to right, Weardale Perfection, King Alfred, Glory of Noordwijk; lower, Olympia, Van Waveren's Giant. United States Bellingham Bulb Station, Bellingham, Wash.

gated into 11 divisions, based mainly on the relation of the perianth to the corona, and the divisions have been further subdivided on the basis of color.

The classification that follows is copied from the report of the committee. The writer has endeavored to add examples of well-known varieties to each class.

Division 1. Trumpet daffodils.—Trumpet or crown as long as or longer than the perianth segments.

- a. Varieties with yellow or lemon-colored trumpets and perianth of same shade or lighter (but not white). King Alfred.
- b. Varieties with white trumpet and perianth. Madame de Graaff.
- c. Bicolor varieties, having white or whitish perianth and a trumpet colored yellow, lemon, primrose, etc. Glory of Sassenheim.

Division 2. Incomparabilis.—Cup or crown not less than one-third but less than equal to the length of the perianth segments.

- a. Yellow shades, with or without red coloring on the cup. Sir Watkin.
- b. Bicolor varieties, with white or whitish perianth and self-yellow, red-stained, or red cup. Cynsure.

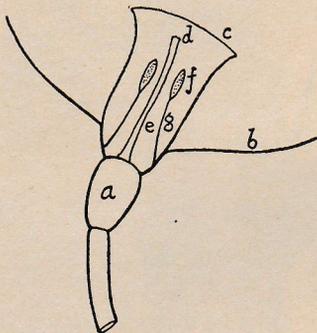


FIGURE 3.—Diagram of a trumpet daffodil flower: a, Ovary; b, perianth; c, trumpet; d, stigma; e, style; f, anther; g, filament

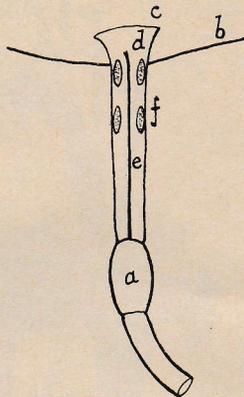


FIGURE 4.—Diagram of flower of poets narcissus: a, Ovary; b, perianth; c, cup or trumpet; d, stigma; e, style; f, anther

Division 3. Barrii (incorporating Burbidgei).—Cup or crown less than one-third the length of the perianth segments.

- a. Yellow shades, with or without red coloring on the cup. Barrii Conspicuus.
- b. Bicolor varieties, with white or whitish perianth and self-yellow, red-stained, or red cup. Lady Moore.

Division 4. Leedsii.—Perianth white, and cup or crown white, cream, or pale citron, sometimes tinged with pink or apricot.

- a. Large trumpets, with cup or crown not less than one-third but less than equal to the length of the perianth segments. White Queen.
- b. Small trumpets, with cup or crown less than one-third the length of the perianth segments. Ariadne.

Division 5. Triandrus hybrids.—All varieties obviously containing *Narcissus triandrus* blood.

- a. Large crowns, with cup or crown not less than one-third but less than equal to the length of the perianth segments. Queen of Spain.
- b. Small crowns, with cup or crown less than one-third the length of the perianth segments. Agnes Harvey.

Division 6. Cyclamineus hybrids.—Derivatives of *Narcissus cyclamineus*. Silver Cycle.

Division 7. Jonquilla hybrids.—All varieties of *Narcissus jonquilla* parentage. *N. odoros campbellii*.

Division 8. Tazetta and Tazetta hybrids.—To include *Narcissus tridymus*, poetaz varieties, Dutch varieties of polyanthus narcissus, *N. biflorus*, *N. muzart*, and *N. intermedius*.

Division 9. Poeticus varieties.—Contains the poets narcissus and the extensive list of garden hybrids. Poeticus Ornatus.

Division 10. Double varieties.—Double-flowered varieties of all groups included. Double Van Sion, poeticus Albus Plenus.

Division 11. Various.—To include *Narcissus bulbocodium*, *N. cyclamineus*, *N. triandrus*, *N. juncifolius*, *N. gracilis*, *N. jonquilla*, *N. tazetta*, *N. viridiflorus*, etc.

The classification is useful in various ways. Designed as it is primarily as a guide for exhibitions of daffodil flowers, it is indispensable for that purpose. It may also be employed in various ways to save wordy descriptions, in that a simple designation like 1-a to the daffodil fancier immediately places the flower in question among the long-trumpet daffodils, which are all of the same or different shades of yellow. The list (8) is indispensable to the student of daffodils, if not to the serious amateur.

HISTORY

No attempt need be made to cover the early history of the daffodil, for that has been well done by many competent authorities. A few references, however, are given in regard to the modern development of the daffodil and a few of the sources from which information may be derived. Nearly all of these give further references.

The treatise on the genus *Narcissus* by Burbidge and Baker (2) is classical and may well form a starting point for the practical gardener. It gives the history, classification, and complete exposition of the group and is copiously illustrated in color. Bourne (1) has given a résumé in book form with descriptions of the varieties, their uses, and cultural directions, based on intimate knowledge. Kirby (7), who has complete familiarity with the culture, merchandising, and forcing aspects, has covered the subject from an American viewpoint. His is the only American book on the subject. Jacob (6) published a very useful and popular book in 1910. Another very useful book is that published by Sydenham (10) in 1913. It is unique in that it gives not only cultural directions but also brief, concise descriptions of all varieties known to the author, together with prevailing prices. Hartland (5), of Cork, Ireland, is said to have issued the first catalogue of daffodils.

While it may not be necessary for the daffodil grower to have a copy of the Classified List of Daffodil Names (8), this work is indispensable to the student. It contains a list and classification of all names known to the authors, together with an outline of the system of classification and the names of the originators of the varieties when known.

One of the most comprehensive books ever written on daffodils came from the press in 1929. It was written by Calvert (12) and covers the subject admirably from the English point of view. Its main value to American horticulturists consists in its up-to-date estimates of the newer varieties.

The journal and the yearbooks (issued occasionally) of the Royal Horticultural Society, London, and the annual reports of the Midland Daffodil Society, Birmingham, England, contain in concentrated form

information on all phases of daffodil breeding, culture, use, and handling.

Catalogues of seedsmen and bulb growers present valuable information on the culture, characteristics, and adaptability of narcissus varieties. Some firms issue special bulb catalogues and others publish books of directions for the culture of narcissus and other bulbs.

Some of the most valuable information about daffodils appears in current periodicals and florist and other trade papers. Consequently, anyone interested in daffodils should read one or more garden or trade papers.

DECORATIVE VALUE

There are few decorative plants so adaptable as the daffodil, or that can be enjoyed for so long a period. The Paperwhite (Paperwhite Grandiflora) can be made to blossom for Thanksgiving, and *Recurvus* and *Alba Plena Odorata* will blossom outside from late April to Decoration Day, depending upon the location and the latitude. Between these two extremes there need be no time without daffodils in flower either in the field, living room, conservatory, or greenhouse.

Daffodils proclaim the arrival of spring; they add both a boldness and a delicate, charming touch to the landscape; they are adapted to open woodlands, meadows, and rocky declivities; they are charming in beds and borders and may be employed even in the lawn and in the edges of pathways; they are most effective as pot plants for house decoration in soil, water, pebbles, or fiber; they have scarcely a peer as cut flowers when employed with their own leaves or almost any other greenery.

COMMERCIAL IMPORTANCE

No better proof of the popularity and importance of the daffodil is needed than a bare statement of the quantities used in this country until recently. The numbers used have fallen off of late, but it is likely that they will come up again as supplies become more plentiful.

It is not possible to determine just what the consumption of bulbs and flowers is now, but in the recent past there were imported annually for decorative purposes, mainly for greenhouse and home forcing, 40,000,000 Dutch daffodil bulbs and about an equal number of Paperwhites and other tender varieties. Besides these there were many millions of blossoms cut and sold from out-of-door plantings. The value of the bulbs used in these ways was probably close to \$2,500,000, and the expenditure for the cut flowers more than twice that sum.

Besides these quantities, the large numbers enjoyed in beds, borders, and other semipermanent and naturalized plantings are to be taken into account. Although there are sections of the country where daffodils are not grown and where the cut flowers are seldom seen, their use is very extensive and important.

REGIONS TO WHICH THE DAFFODIL IS ADAPTED

While there is no region where all daffodils can be grown successfully, there are few indeed where some of the varieties can not be produced well enough to be enjoyed in the border, woodland, or meadow. The regions where they can be grown for decorative purposes are fortunately very much more extensive, and conditions are infinitely more varied than those adapted to the commercial production of the bulbs.

In any consideration of the geographical adaptability of the daffodils a sharp distinction should be drawn in the beginning between the tender polyanthus group and the more hardy trumpets, poets, etc. It has become customary to group these tender and hardy varieties as south France and Holland stocks, respectively, and free use is made of this rough classification in these pages. This has come about because it has been from these two regions that we have been accustomed to secure the two classes of bulbs. From southern France have come the Paperwhites, Grand Soleil d'Or, and Double Roman, especially, and from the Netherlands the vast majority of the other daffodils. From the warm regions about Amoy, China, has come the Chinese sacred-lily.

It is to the warmer regions, therefore, that this tender group must be rigidly confined. California, the Gulf States, extreme southern South Carolina, and Georgia are demonstrated possibilities. Attempts at the culture of this group are being made as far north as Wilmington, N. C. The hardy group is applicable to a still more varied series of conditions. The Dutch stocks are now produced in the Pacific Northwest, in the northern tier of States, in the Atlantic coastal plain as far south as the Carolinas, and in many interior locations such as portions of Illinois, Tennessee, and Indiana.

Naturally between these two extremes there is a wide area which may be looked upon as a sort of no-man's daffodil land, where both groups may be more or less satisfactorily grown, for decorative purposes at least but not commercially. Both the Paperwhite and the Chinese sacred-lily will flower at times as far north as Washington, D. C., and the trumpet daffodils are often seen in northern Florida, while the true jonquils and their derivatives can be grown in the South Atlantic States. Some of the so-called Dutch varieties produce better in the warmer portions of the Dutch daffodil belt than in the colder. This is particularly true of such forms as Gloria Mundi, and probably of Ard Righ and some of the poetaz varieties.

While the Dutch group in general may be said to be adapted to the Atlantic coastal plain, for instance, there are many qualifications, exceptions, and reservations that need to be made. There are two striking examples that should be noted of the most exacting requirements for successful production.

The old Lent lily, or Double Van Sion as it is now called, is one of the particular varieties. It must be grown where the atmosphere does not get hot during any portion of the year. Throughout the Atlantic coastal plain the flowers turn green and split excessively, becoming of little if any decorative value. The plants, however, are

healthy, and the bulbs develop quite satisfactorily, although it may take two or three years of good culture under adaptable conditions to bring the flowers back to normal. To produce this variety satisfactorily, one must resort to Cape Cod, Puget Sound, or some such region where the humidity is ample and the mean temperatures low. Many doubles, such as Holland's Glory and Double Sir Watkin, also turn green.

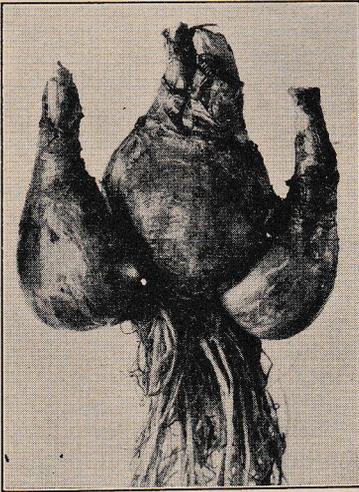
The conditions required for the satisfactory culture of *Alba Plena Odorata* are very similar to those required for Double Van Sion, but the reaction on the plant is very different. Either hot or dry weather will blast the flowers of the former. The variety was very commonly grown in yards in a small town in southern Indiana some years ago, but no grower ever saw a flower. It is very seldom that flowers

are seen at Washington, D. C. It flowers satisfactorily in northern New York. In the cape region of Virginia it blossoms very early, before the hot weather comes on, and is said often to open 50 per cent of its blossoms.

The ideal climate for the production of Dutch daffodils has a decided winter but no very severe weather. The best summer has a uniformly low average temperature without high heat. The rainfall should be copious during the growing season, September to June, and the atmosphere should have a relatively high humidity.

As these ideal conditions are departed from, difficulties of culture are encountered. High heat is especially detrimental during either the growing or the storage season. If

FIGURE 5.—Golden Spur from double-nosed bulbs left undug for two years



heat or drought occurs during the growing season the growth is interfered with, but if hot weather occurs during the harvesting and storage seasons the bulbs are prone to rot. In short, difficulties of culture are multiplied greatly for the Dutch stocks as culture is attempted in regions having hot summers, which make necessary much more careful handling.

Fortunately a hot region, poorly adapted to commercial culture of the Dutch stocks, may be very well suited to the culture of the same stocks on a let-alone basis wherein the bulbs are disturbed but seldom and are grown with more or less of a protective covering of grass, leaves, etc., which shields the soil from excessive heat during the dormant season of the bulbs or during severe freezing in winter.

THE DAFFODIL BULB

The bulb (fig. 5) of the daffodil is made up of closely appressed concentric layers not essentially different from those of the onion.

The scales are attached to a heavy basal plate, which the botanist looks upon as a modified stem. The scales are looked upon as thickened and enlarged leaf bases.

These analogies are perfectly borne out in the behavior of the bulb during reproduction, when daughter bulbs are formed, which are usually referred to as splits, slabs, propagation, or increase. When the bulb reaches a certain size, the maximum size for the variety, buds develop in the axils of one or more of the bulb layers, just as the bud develops in the axil of the leaf on an apple twig. They are homologous and comparable structures, but in the case of the daffodil the bud continues its development until it separates from the old bulb and becomes an independent entity, carrying with it a portion of the scales of the old bulb and robbing it also of a portion of the basal plate (stem).

The daughter bulbs in the daffodil contain or absorb a portion of the substance of the original or old bulb. In the daffodil, therefore, the old bulb persists indefinitely, being renewed or replaced by new leaf bases within and a transformation of the older outer layers into thin membranous coatings, finally useless except as protective coverings, which are abraded and worn off as the years advance. This is a very different condition from that found in the tulip, wherein a number of buds, 2 to 6 or 8, develop each year into new bulbs which are entirely new structures, partaking in no way of the structure of the old bulb, but being simply an out-growth of it.

The development of the daffodil bulb is from within. Each season three or more leaves and the flower stem develop from the center. The dilated bases of these leaves become additional concentric layers, which push the old layers out as the season advances in proportion as they themselves expand, thus enlarging the size of the bulb and being themselves pushed outward another season.

REPRODUCTION OF THE BULB

Before a grower is in a position to produce daffodils intelligently, he must have in mind clearly the behavior of the different categories of the bulbs. Not that the growth is fixed and definite, for it varies as with all living things; but there is a general plan which is after all quite uniform.

In Figure 6 (Golden Spur, which may be taken to represent the Dutch daffodils generally) are represented four categories of bulbs, namely, splits, round, double-nosed, and mother bulbs. In general it may be assumed that one season's culture will transform one of these classes into the next one above it, so that the cycle of development from a good-sized split to a well-divided mother bulb, which will contain several splits, will be three years.

This may be taken as the general method of development and growth. The method is, however, varied. The behavior is different in different varieties. Some conform very closely to the procedure outlined above, producing at the end of three years quite uniformly only one or two offsets. Other varieties at the end of three years may yield three or four times that number.

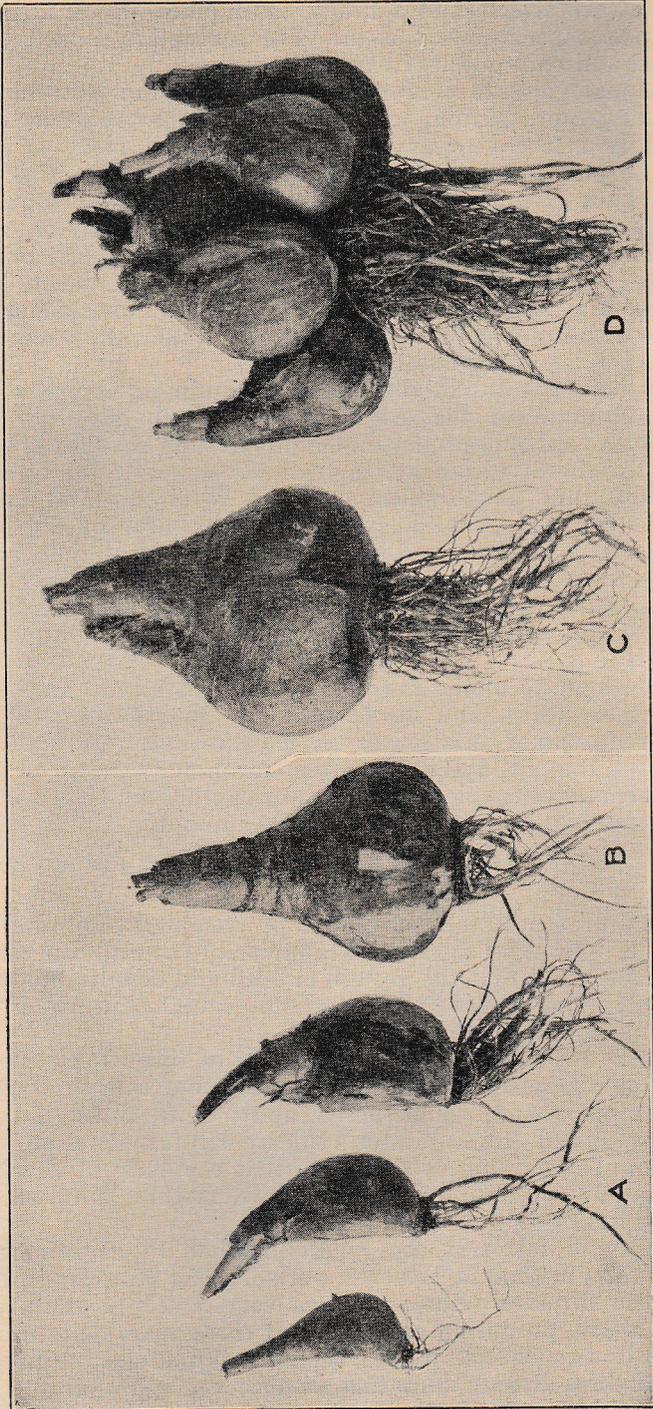


FIGURE 6.—Golden Spur bulbs: A, Slabs; B, round; C, double-nosed; D, mother bulb

The reproduction in the Paperwhite and Chinese sacred-lily (fig. 7) is not essentially different from that described above, but the number of splits produced is very large, and they are inclined to take place early.

At 1 year of age the seedling of the preceding year will be found to be round and symmetrical or slightly elongated.

(Fig. 8.) During the second and third years the bulb becomes decidedly elongated, because of the influence of the long, stout, contractile roots, which proceed directly downward and pull the bulb down to the proper depth from the shallow position of the germinating seed.

About the fourth or possibly not until the fifth year the seedling bulb will have assumed the aspect of a mature bulb, will be round and symmetrical, and will have attained a circumference of 12 to 15 centimeters.

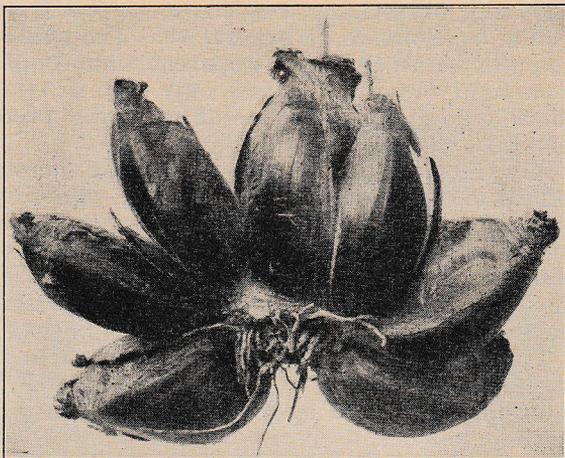


FIGURE 7.—Chinese sacred-lily bulb grown on heavy, moist land at Doctors Inlet, Fla.

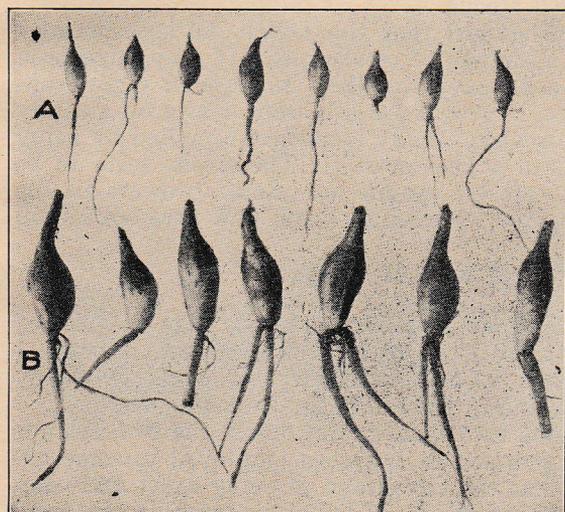


FIGURE 8.—Daffodil seedlings: A, King Alfred, 1 year of age, about 2 centimeters in circumference; B, Glory of Noordwijk, 2 years of age, about 4 centimeters in circumference. Note elongated bulbs

If such a bulb is cut open transversely late in the season a division is very likely to be found already outlined. The next (possibly the sixth) year a double-nosed bulb results, and the seventh year a split may be taken off, commonly still a double-nosed bulb, which will go through the cycle of development already described.

SOIL PREPARATION

For good results the soil in which daffodils are planted should be naturally

friable and well and deeply cultivated. The importance of this will be seen when it is realized that the roots go down in soil of the proper tilth 12 inches or more, and the bulbs are all covered

with 4 inches of soil. It is evidently necessary to have the soil in tilth to such depth that the roots can penetrate easily and without getting into water standing over a hard impervious subsoil. Thorough pulverizing, rendering the soil friable and of easy penetration by moisture, is imperative. The necessity for such preparation will be all the more apparent when it is realized that there is opportunity for deep culture only once in two years when a year is missed in digging or in case of cut-flower production at even longer intervals.

A daffodil bulb can not develop as it should in soil that packs or solidifies around it. Its development is arrested by hard-soil pressure, so that the bulbs do not attain proper growth. This has been witnessed time after time at the United States Bellingham Bulb Station at Bellingham, Wash. Even with good and deep tillage the packing of the soil in autumn by the liberal use of a hand tractor has reacted to reduce the development of the bulbs.

The grower should not be satisfied with a ground preparation less than 18 inches in depth. Of course it is not always practicable to attain this depth all at once, but it should be the aim to reach it as soon as possible. The plowing should be deep, and a subsoiler should be used after the plow. There should be no chance for the accumulation of water within 18 inches of the bulbs.

BENEFIT FROM CHANGE OF LOCATION

Daffodils are not exacting in their soil requirements. They are successfully grown on both sandy loams and quite heavy clays. Nor is this adaptability restricted to any one group. It holds for both the Dutch and the French stocks.

However, it is well recognized that the Dutch stocks especially are greatly benefited by a change of conditions. If they have been grown for some years on a heavy soil they increase in vigor, condition, and productiveness if grown for a season or two on a sandy loam. Likewise stocks grown on sandy loams are benefited by being transferred for a period to a heavier soil. The stocks seem to be invigorated by a change of soil conditions. Some growers in the Northwest are alternating between sandy loam and peat soils with apparent success.

PLANTING

Like other crops of wide adaptability, daffodils may be planted in many ways. As yet there is no best way. At least, it has not yet been determined what way is best for this country. Many methods are in use and are likely to be for some time to come.

In both large commercial and small operations in the Netherlands the bed method is in vogue, and it has been employed to some extent in this country. It has the advantage of being exact and compels the most intensive use of the land, but it is expensive in hand labor.

The plan is best carried out in rectangular plots 30 to 50 feet wide. The length of the beds is the width of the plot. The beds, which are 3 feet wide with 12 to 18 inch paths between, are carefully laid off for the entire plot. The beds are marked off with a

spade along taut lines drawn along each side, the spade being thrust vertically into the soil to a depth of 2 to 4 inches and then pulled inward toward the center of the bed. The soil is thrown out of the first bed to a depth of 3 to 6 inches, depending upon the size of the bulb to be planted. The bottom is then raked level and a marker run through to place the rows, which are mostly 6 inches apart.

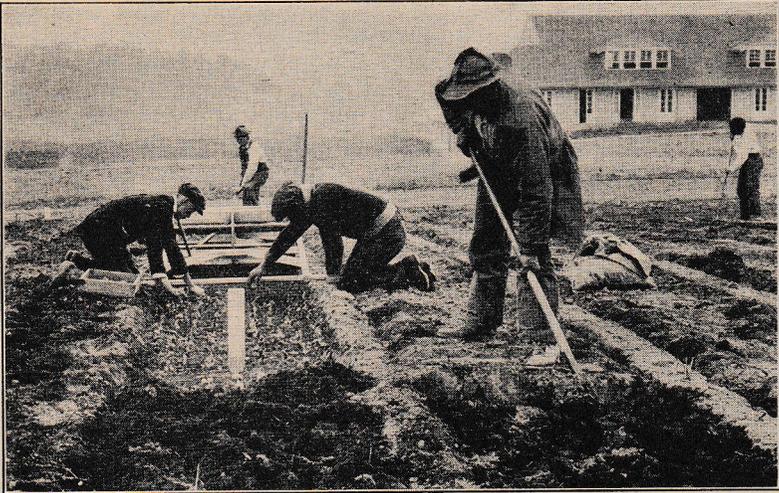


FIGURE 9.—Bed planting of daffodils

Two boys working on their knees on either side of the bed set the bulbs. The planting is then covered with soil from the next bed; thus one bed is opened and the bulbs in the other are covered in one operation. This process is repeated over the entire plot. (Fig. 9.)

A good crew for this plan of planting consists of two men and two boys. One man opens a bed and covers the bulbs in the other, and

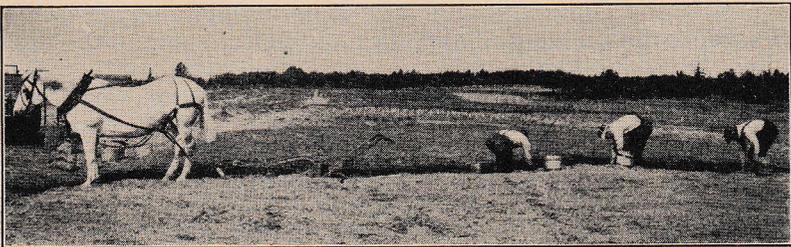


FIGURE 10.—Row planting of daffodils in furrows

one rakes the bottom of the bed and applies fertilizer if any is to be applied. The two boys run the marker, keep a record of the planting, and set the bulbs. A third boy can often be profitably employed to mark off the beds and assist where needed in the other operations.

Another good way is to plow the bulbs in. (Fig. 10.) To do this it is necessary to arrange the hitch so that the horse walks on the

unplowed land. A plow is employed to give the width of row desired, and the bulbs are set in every furrow.

At the Bellingham Bulb Station a 10-inch plow is crowded to give about a 12-inch row. The implement has been modified in several particulars and is considered to be quite successful. (Fig. 11.) It has an ordinary stubble moldboard, to the distal end of which has been bolted a moldboard from a 6-inch hand-tractor plow. This pushes the soil over farther, thus leaving the land level. Attached to the inside of the land side and braced from the furrow-side handle is a piece of heavy strap iron, which makes a mark in the base of the furrow slice where the bulbs are to be set. Attached to the beam is another strong piece of strap iron, to which is hung a small drag which marks the position of the next furrow. There is also attached the ordinary wheel guide to gauge the depth of the plow. The soil is all turned one way, which necessitates driving back empty each time, unless one wishes to work the area

in lands, with a back and dead furrow in each.

Eventually perhaps some of our implement companies will adapt the sidehill-plow principle to an implement adapted to the planting of daffodils and other bulbs. This would necessitate a modification of the type of moldboard, the substitution of a light wooden beam, and a steel instead of the heavy cast construction usually employed at present.

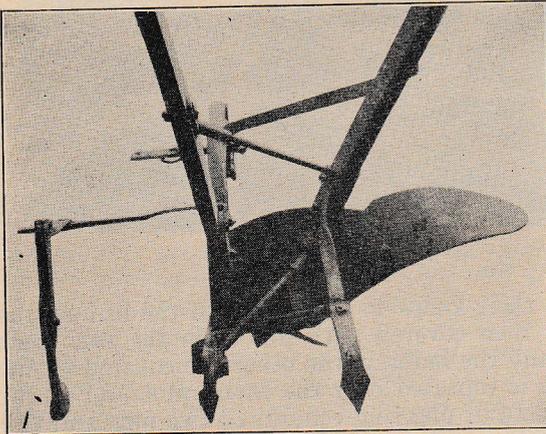


FIGURE 11.—A 10-inch plow adapted to plant daffodils in rows

Probably the majority of daffodil bulbs in this country are planted in rows by means of some form of shovel attachment which opens up a furrow of proper depth for setting. Often these are used in gangs to open up as many as four rows at a time. (Fig. 12.) At times sweeps are employed to open up a wide space wherein two or three rows are set close together, thus making in effect a narrow bed with wide spaces between. The double and triple rows are commonly set 3 feet on centers for power digging.

Some growers have adapted a potato planter to the planting of narcissus bulbs. The greatest objection to this is that it is not possible by its use to set the bulbs up, which is especially disadvantageous with the larger sizes.

PLANTING FOR ORNAMENTAL PURPOSES

Planting for ornamental purposes is not essentially different from planting to produce bulbs commercially. Commonly, however, somewhat more care should be taken to plant the bulbs a uniform dis-

tance apart and at a uniform depth. In formal bedding these two factors are quite important, for uniformity of blossoming can not be attained with different depths of planting.

Where beds and borders are to be solidly planted to daffodils, it is a good plan to excavate the space as one would a bed in the Dutch method and then work the bottom thoroughly, incorporating whatever fertilizer has been decided on. If the bulbs are large, it may be necessary to set them with a trowel, but it is much easier to get uniformity if 3 or 4 inches of the surface are removed.

The common method is to set daffodil bulbs in tilled soil with a garden trowel, and this serves most purposes very well. It is a little difficult, however, to get the uniformity necessary this way when the bulbs are set 5 or 6 inches deep.

A great deal of ornamental planting is done with a dibble, which may be improvised by sharpening the broken end of a D-handle spade. The ground must be soft before this tool can be used advantageously. It is thrust into the soil and then wiggled around until the hole is large enough to let the bulb down to proper depth.



FIGURE 12.—Planting Paperwhite narcissus bulbs in southern California. Four rows, 36 inches apart, are opened at one time

The bulb is then put in and covered by pulling some of the surrounding soil over it. Some growers object to this method on account of the empty space left under the bulb. It may be said that the space is always moist and never persists longer than part of the first winter. This probably is not a very serious matter. On the whole, dibble planting is not satisfactory for most of the large commercial daffodil bulbs, but it answers better with the smaller sizes.

NATURALIZED PLANTINGS

Planting daffodils under noncultural, ornamental conditions differs decidedly from the geometrical arrangements of beds, whether for commercial or ornamental purposes. It takes place mostly in firm, undisturbed soil, is preferably if not imperatively unconventional, and it is done where there is more or less competition from other plants.

Everything considered, the mattock is about as satisfactory a tool as can be found for use in planting in grass or other natural situations, provided the ground is not too firm and the soil is not too tenacious. The bit should be thrust the full length, then the slice

pried up sufficiently to get the bulb down to the proper depth. It does not matter if it is at an angle, but the neck of the bulb should be 4 inches deep and preferably 5 or 6 inches for best results.

If bulbs are large and the sod tough, a spade may work better for the same kind of a planting. The blade is thrust in full length at an angle of 45°, then pried up so that the bulb may be shoved down under the back to a proper depth. When the tool is removed the sod is pushed back into place with the pressure of the foot.

Often it is desirable to remove a sod of greater or less size, work up the subsoil, set the bulbs, and return the sod to its place again. This has decided advantages where the turf is tough and the subsoil hard or lean, for bone meal or other fertilizer may be easily incorporated as the soil is being worked up.

A dibble may also be employed for planting in grass, provided the sod is thoroughly wet just before planting, and provided further that the bulbs are small. In such an operation it is necessary to fill the hole above the bulb with foreign soil. If the planting is reasonably thick it is advisable to dump a barrow load of good soil on the dibbled-in area and then scatter it, filling the holes with the back of a rake. This not only covers the bulbs well but also helps the grass. The main objection to this plan is that it is difficult to get the bulbs deep enough.

While a geometrical design is advised for both commercial and formal bedding, it is the last thing to be desired in naturalized plantings. Informality and irregularity should be the watchwords. Lack of regularity fortunately is not difficult to attain. Even where sod is removed over a definite area, the bulbs when set can be informally arranged so that straight lines, uniform curves, regular angles, or uniform densities are avoided.

Little need be said of the scenic advantages to be derived from the utilization of daffodils in the landscape, in open woodlands, in glades, on stream banks, and in other settings where they are not disturbed for years. A number of such extensive plantings are familiar, some of which have functioned for a century with little care or attention. In foreign countries such use of the daffodil is much more prevalent than in the United States. It is from such plantings that inspiration for much of the poetical appreciation of the daffodil has come.

There are two particularly striking and extensive examples of the commercial utilization of naturalized plantings of daffodils in this country. One is in tidewater Virginia (fig. 13) and the other in southern Illinois (fig. 14). In both cases the bulbs have been left undisturbed in grass for 10 to 20 years. In the former location *Spurius* (Trumpet Major) has been employed, and in the latter *Emperor*, *Empress*, *Conspicuous*, *Ornatus*, *Sir Watkin*, and *Golden Spur*. Such handling produces mediocre flowers, which, however, have been consumed in large quantities in midseason and late season. A variety similar to *Golden Spur* is occasionally naturalized in the State of Washington (fig. 15), and there are less extensive naturalized areas in many States, particularly in Ohio, Georgia, Tennessee, and Oregon.

Aside from the occasional partial harvesting of the flower crop, naturalized plantings, or plantings allowed to go to grass for five or more years, have another important commercial aspect. Such plantings may be made the basis and source of stocks for field culture.

It is well recognized that stocks cultivated and handled annually for a long time are wonderfully invigorated when naturalized for a period of years. The bulbs dwindle in size to such an extent that they are



FIGURE 13.—An old naturalized planting of Spurius in Virginia. The planting has been undisturbed for 14 years

scarcely recognized as the same varieties, but when again brought under culture they come up to commercial size very rapidly and show increased vigor. This sort of handling is said to have been practiced especially with Golden Spur in the Netherlands.



FIGURE 14.—Emperor in sod undisturbed for seven years in southern Illinois

There has been opportunity to study several such naturalized stocks during the past 10 years. Experience with them agrees with the general verdict that the stocks are improved by such periods of non-handling. Double Van Sion of this character from Virginia was

handled in 1917, and Spurius from the same region later. Emperor, Ornatus, and Sir Watkin, from southern Illinois, were received in 1922.

In order that such naturalized bulbs may be again utilized in commercial cultures, it goes without saying that the varieties must be planted separately. Even for ornamental purposes this practice is desirable because of the better effect of solid colors and also because of the uniformity in season of blossoming.

DISTRIBUTION OF PLANTING MATERIALS

For any uniform distribution of the bulbs at planting time it is necessary that they be carefully sized in some such way as that described on page 29 and the following pages. This is important in order that the turn off at the next digging may be estimated, because the crop should be sold long before it is dug. In intensive methods of culture, such as the bed system presupposes, uniform distribution for the purpose of cropping all areas alike and to the limit can be attained only by uniform sizing. Uniform cropping may not be so important a factor in the extensive American systems, but it is important in any planting to be able to forecast at planting time the crop to be dug.

The actual sizes made may vary greatly. The moderate grower without machinery may size his bulbs by hand quite rapidly and with a measure of satisfaction into splits, rounds, and double-nosed, in both Dutch stocks and the polyanthus groups. However, four or five sizes are much more accurate and satisfactory.

Each grower must work out his own segregations, and they must be close enough to give a fairly accurate picture of the harvest to come and to accomplish a uniform loading of the land. The segregations practiced at the United States Bellingham Bulb Station for both bed and row plantings will be of suggestive value to the grower in the adoption of sizes suited to his conditions and practices.

The sizes, although not always the same, have been mainly five in number, 6 to 8 centimeters, 8 to 10 centimeters, 10 to 12 centimeters, 12 to 14 centimeters, and over 14 centimeters in circumference. For the heaviest cropping in beds the first size mentioned may be set 35 to the 3-foot row, the second 21, the third 14, the fourth 11, and the fifth 9. If bulbs smaller than 6 centimeters in circumference are planted they may be strewn along at the rate of 50 to the row, and large double-nosed bulbs may be set 7 to the row.

These spacings represent very heavy setting, probably the limit under heavy fertility, and possibly a little too heavy under most conditions, in that there may be danger of the foliage maturing and dying prematurely because of poor aeration. The planting can be thinned in two ways. The number to the row may be stepped down one notch, or the rows may be made 9 inches apart instead of 6, or both methods may be adopted.

In 12-inch row plantings at the United States Bellingham Bulb Station it has been the practice to set the large bulbs about three to the foot and the other sizes progressively closer until the 6 to 8 centimeter bulbs are placed only half an inch apart. When those below 6 centimeters are planted they are often distributed thickly without definite placement. Bulbs smaller than those which would be planted 11 to the row are not usually set up.

The Paperwhite, the Chinese sacred-lily, and the French Soleil d'Or produce a larger top growth, are more vigorous, and must be given more room than most of even the large Dutch stocks. In row



FIGURE 15.—An old variety closely resembling Golden Spur, which has been undisturbed in this position for 20 years. It has been in the United States for 40 years. The past 3 years it has been cultivated somewhat, and is now sold as Pacific Spur



FIGURE 16.—Paperwhite narcissus plantation in Florida. This is the second year without digging of forced bulbs. Cowpeas were sown over these as soon as the tops died the first year

planting (fig. 16), such as is universally practiced with these varieties, there is little danger of overcrowding because of the wide interrow spaces.

USE OF FERTILIZERS

It is always the safest plan for the grower, unless he has had enough experience to be considered expert in daffodil culture, to see to it that the ground planted is sufficiently fertile; that is, moderately fertile for ordinary crops without the addition of any animal manures at the time of planting. If such land is not to be had, the safer plan is to apply manure, grow some other crop on it the first year, and then plant daffodils. It is not intended to convey the idea that it is not possible to apply manure to this crop at the time of planting, but only that such practice is fraught with danger unless it is carried out with rare judgment. If manure is applied, it should be applied in moderation. It should be well decomposed and fine, so that the incorporation can be well-nigh perfect, or it can be plowed under very deep; otherwise basal rots are likely to be induced by the action of the fermenting particles in the soil, from the effect of which the young roots soon decay, and this decay extends to the base of the bulb.

The time was when the writer had no hesitancy in using horse manure as a top-dressing during the winter for daffodils. In recent years, however, a liberal use of 1-year-old leached material has proved to be the cause of much rotting of the stocks, so that now he is inclined to advise the elimination of such fertilizer unless an intervening crop can be grown. Such cautions do not apply with so much force to cow manure, but even with that daffodils may also be injured by poor incorporation of the raw fertilizer. In short, it is better to keep animal manure in a raw condition away from daffodil bulbs.

Experience with commercial fertilizers is too limited yet to serve as a basis for very definite recommendations, but a few factors are fairly well established.

The requirements that have been established for a potato crop in any particular region will serve as a fairly satisfactory guide for the fertilization of daffodils. Sulphate of ammonia is preferred to nitrate of soda, and at least a part of either should be replaced with some organic source of nitrogen. For the small grower who uses ready-mixed material a 4-8-10 formula³ is suggested, but a much heavier application of potash is often used.

One English authority advises for daffodils 1 part by weight of kainit, 2 parts mineral phosphate, one-half part nitrate of soda, and one-fourth part iron sulphate. This is mentioned on account of the inclusion of iron, which has been recommended in this country by some and is recommended for the chalky, iron-deficient, leachy soils, but probably is seldom needed in this country, where iron is abundant.

The writer has felt well satisfied with a chemical fertilizer applied at the rate of 800 pounds to the acre on top after planting, with 1,000 pounds of commercial raw bone meal plowed under before planting. This was for very heavy cropping.

The quantity applied and the time of application will vary with conditions. On lean, leachy soils two and possibly three applications

³ Percentages, respectively, of nitrogen, phosphoric acid, and potash.

are to be preferred, one at planting time, one two weeks before blossoming, and the other three or four weeks later.

The total application per acre will vary with the natural fertility of the soil, the method of application, and the density of the crop. In intensive bed culture in the North, or in the 15-inch row culture of Paperwhites in the South, 1 ton to the acre is common usage, and twice this quantity seems to have been used with profit on southern sands.

CULTIVATION

The cultivation of daffodils when planted in beds is a comparatively simple matter and is neither burdensome nor irksome if the labor is performed punctually. Contrary to the general belief, but little handwork is necessary on the beds except with certain varieties which are weak growers, do not cover well, or do not, for any reason, make thick or perfect stands. Toward spring the use of the weeder knives must be dispensed with, and some form of scratching or harrow attachment should be used in the cultivation.

After the plants are 2 inches high no form of wheel-hoe cultivation is practicable on any miscellaneous planting of daffodils, and with most of the vigorous varieties none is necessary, for soon after this they cover the ground so as to keep weeds down quite well. Weeds can not be much of a factor in a heavy crop. After this there is a reversal of the cultivation. Weeds will still grow in the paths, where there is less shade and competition. The cultivation before the plants are up is done across the beds usually, but after this it is directed along the paths only.

When the variety for any reason does not cover the ground fairly well by the time it is in blossom, handwork is necessary. In this case a light narrow hoe with the blade about 3 inches wide is preferred to be used between the 6-inch rows. A 3-prong cultivator hoe is also employed. One good job of cleaning out the weeds is usually all that is necessary even under those conditions.

In regions where weeds grow all winter the case is different, and the bed system, to a proportional degree, is less advantageous.

When the planting is in narrow rows, the autumnal cultivation need not differ from that of the beds, and weeder knives may be employed until the plants come up close to the surface. After that a scratcher attachment may be used. When the plants are up so that the rows can be followed, a wheel hoe or a garden tractor with attachments to cover several rows may be employed.

Cultivation, wherein the wide row is employed, is more difficult in autumn before the plants are up, unless the position of the row is kept permanently visible by the ridging of the soil over it or by some other method. This practice is commonly employed. Then cultivation can take place between the rows without injury from horses walking on the bulbs, which should never be allowed because irreparable injury is done by an animal footfall over a bulb in soft ground.

One element in the cultivation of bulbs is likely to be lost sight of if culture is on heavy soil and precipitation is inclined to be copious. It should never be forgotten that daffodils require a friable soil for

proper development. It is very easy to pack certain soils with hand-tractor or horse-drawn tool cultivation so as to interfere with the proper growth of the bulbs. The Bureau of Plant Industry has experienced just this kind of difficulty on the rather heavy silt soils at Bellingham, Wash. It is necessary in this location to do a large amount of work on the plantings in autumn to keep down weeds. The use of a hand tractor in the fall has packed the soil so badly that it has been abandoned. On friable sandy loams the packing injury would not be so serious, but the possibility should not be lost sight of.

The greater part of the cultivation of daffodils should be done before the bulbs are planted. There should be little need for further cultivation except to keep down weeds. Indeed, in a thick planting there is little opportunity to cultivate deep enough to pulverize the soil to any appreciable depth. Consequently, any practice that tends to pack the soil about the bulbs should be avoided. In wide rows, on the other hand, the situation is quite different, for the wider spaces permit of deeper cultivation.

ROGUING

Inadvertent mixtures are prone to take place in bulb culture. For this reason, if for no other, two crops of daffodil bulbs should not succeed each other on the same ground, for there is no surer way of mixing stocks. During the time the plants are in blossom any stray individuals not of the desired variety can most easily be detected and removed by the use of a special spud which has a long stout blade, 2 to 2½ inches wide, set in a strong handle. Several examinations of the plantings are necessary during the season, each bed being gone over to detect plants that are growing in other than their proper places. In removing the plants the spud blade is driven down close to the bulb, then by prying on the handle the roots are broken off, and the whole plant may be pulled up easily.

This process of roguing is a very important one, not only in daffodil culture but in the culture of all bulbs, for if the grower neglects this aspect of the work his stocks are likely to get into such condition that they can be sold only as cheap mixtures.

Not only should plants of another variety be rogued out of a stock, but runty or otherwise imperfect bulbs should be taken out at the same time. There is a tendency for undersized and otherwise imperfect bulbs to accumulate if the grower depends largely on mechanical sizers and little on hand picking when bulbs are dug. To keep stocks up to vigor and type, advantage should be taken of every opportunity to get rid of the unfit.

What should be done with the rogues will depend entirely upon circumstances. Wherever they are identifiable and of desirable varieties they can be segregated and heeled in at the ends of the beds or rows in which they belong. When dug they can be included with the planting stock and will make first-class bulbs after another year's growth. More often, though, the rogues are heeled in together in some out-of-the-way place where they can be disposed of when dug as the cheapest of mixtures. The runts and otherwise imperfect or diseased plants should be destroyed.

MULCHING AND OTHER PROTECTION

The covering of daffodils for winter protection has been little resorted to in any portion of this country. The practice will probably never be followed here because on the extensive scale on which the crop is grown mulching will scarcely be economically practicable. It can be done only with the most intensive culture. Situations in which mulching is necessary may not be able to compete commercially with areas where mulching is unnecessary.

There is no question but a mulch would be beneficial, as, indeed, it would be with many crops, but it is not imperative and probably is not economically feasible under our present conditions on general daffodil crops.

On seedling beds for the first two or three years a mulch is considered imperative. The reasons here are entirely different. The first year the seed, set but an inch deep, needs to be protected from soil disturbance, and for the next year or two from the bad effects of low temperatures on the shallow and delicate bulbs.

The material for such a mulch may be any form of litter, but one of medium coarseness is preferred. Straw or coarse hay is good. The Bureau of Plant Industry has used rye cut just before being mature enough for the seed to grow. This has been dried and tied into bundles of ordinary size and piled away for the purpose. It is easily applied in early or late autumn and removed again in early spring to allow the plants to come through.

In regions having hot summers, whenever bulbs are left undug it is considered necessary that they receive protection in some form. Dormant bulbs in moist or wet soil whose temperature may get up to 90° F. are likely to suffer. The cheapest and probably the best form of protection in such cases is a growing crop. Cowpeas or soybeans are successfully used and are probably as good protection as can be devised. If the planting is in rows, the seeding can be done while the plants are still green so that the soil is fairly well shaded by the time the daffodil tops are dead.

It is usually necessary to remove such a crop in late summer. Were it not for interference with future cultivation it could be lightly disked in and would serve a useful purpose in adding fertility. It would usually interfere too much with autumn culture for keeping down weeds, and consequently is better removed.

REMOVAL OF FLOWERS

In tulip culture the removal of the flowers is imperative, but in the daffodil the matter is not so important. The objects of flower removal are two in number—to prevent spread of fire blight through decaying of the old flowers, and to prevent seed production, which absorbs too much of the energy of the plant.

In 10 or more years of experience at Bellingham no case has been observed where it was thought that injury resulted from spread of disease by the decaying inflorescence. The seeds produced there are few in number and are confined mostly to the large trumpets. Aside from King Alfred, Van Waveren's Giant, Glory of Noordwijk, Wear-dale Perfection, Great Warley, Glory of Sassenheim, and Spring