

Washington Daffodil Society

THE BULLETIN

OF THE
NORTH CAROLINA DEPARTMENT OF AGRICULTURE
WILLIAM A. GRAHAM, COMMISSIONER
RALEIGH

JANUARY, 1930

Daffodils in Eastern North Carolina

In Coöperation with the North Carolina State College of Agriculture and Engineering and the Bureau of Plant Industry, United States Department of Agriculture.

Entered at the Postoffice at Raleigh, N. C., as second-class matter, February 7, 1901,
under Act of June 6, 1900.

LETTER OF TRANSMITTAL

RALEIGH, N. C., November 25, 1929.

HON. W. A. GRAHAM,
Commissioner of Agriculture,
Raleigh, N. C.

DEAR SIR: I am submitting herewith a manuscript styled "Daffodils in Eastern North Carolina," which has been prepared by Charles Dearing, Assistant Director in Charge, Coastal Plain Test Farm, Willard, N. C. and Dr. David Griffiths, Senior Horticulturist, Bureau of Plant Industry, U. S. Department of Agriculture, Washington, D. C. This manuscript is a report on our coöperative bulb investigational work with the U. S. Department of Agriculture. The information contained herein should prove valuable to the bulb growers of North Carolina and to others interested in the industry. I recommend that this be published as the January Bulletin of the Department of Agriculture.

Very respectfully,

F. E. MILLER,
Director, Test Farms.

Approved:

WM. A. GRAHAM,
Commissioner of Agriculture.



SIR WATKIN

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Daffodils in Eastern North Carolina

By

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AND

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FOREWORD

For many years Eastern North Carolina has been recognized as a section interested in the culture of bulbs, such as caladiums, tuberoses, cannas, etc., but coincident to the establishment of an embargo on the importation of narcissus bulbs interest in the production of this crop greatly increased. Recognizing that the culture of narcissus bulbs in this section would require somewhat different methods because of the relatively warmer climate, it seemed advisable that investigational work be undertaken in order to secure information which would undoubtedly be needed. Accordingly, arrangements were entered into between the North Carolina Department of Agriculture and the Bureau of Plant Industry of the United States Department of Agriculture for the conduct of coöperative work at the Coastal Plain Station, Willard, N. C., this Station representing the agricultural district of the State in which most of the bulb growing was located. The necessity of preparing the land, providing suitable buildings, and accumulating necessary bulb stock for the investigation has somewhat retarded the progress of this project, but it is believed that it is advisable to make available to the growers and other interested people in the district the information which has already been obtained. Accordingly, this publication has been prepared as a preliminary bulletin.

It should be remembered that the authors reserve the right to modify any statements made in the event that further investigation or more complete data should indicate that such is necessary in order to conform to the facts. It is believed that sufficient information has been secured to warrant a publication and that the statements in this bulletin will be useful to the commercial bulb growers of this section, and others contemplating the culture of bulbs either commercially or in the ornamentation of the farmstead.

Under the coöperative arrangement the investigational work is being supervised by the national department and the more or less commercial test and demonstration phases are being handled by the state department.

The reader should not interpret the publication of this bulletin as a recommendation for the general undertaking of bulb culture. The authors believe that not all persons are properly equipped to enter upon the business. This is an industry of an intensive nature, one that requires exact knowledge of methods of culture, handling, and marketing, and in addition more or less capital. Moreover, the novice is likely to make serious mistakes unless he is previously informed upon all the phases of bulb culture. For example, he might purchase varieties which are not in demand on the market or which might be quite desirable in other sections but not well suited to this section. On the other hand, we believe there is opportunity for the right persons and that the soil and climate of the section are well adapted for the culture of many but not all kinds of daffodils. It is hoped that this bulletin will be useful in helping to develop one of the possible lines of diversified agriculture for the Coastal Plain section.

INTRODUCTION

More or less confusion exists in the application of names in the genus *Narcissus*. Therefore a brief survey will be made to decide how names are to be used in this bulletin.

The scientific generic name is *Narcissus*, applying, of course, to the whole group. The word narcissus is also used as a common name in a sense coextensive with its scientific use. Again, the name daffodil, formerly referring mainly to the Long Trumpets, is now employed to refer to the whole genus. Today we speak of Trumpet daffodils, Chalice-cupped daffodils, Poet daffodils, Bunch-flowered daffodils, Double daffodils, etc.

The tradesman commonly uses the term "jonquil" to refer to the Trumpet daffodils. This is confusing, for that is and always has been the name of the members of the rush-leaved group, mainly derivatives of the natural species *Narcissus jonquilla*, a small section. Therefore, there are three names, *Narcissus* (scientific name), narcissus (common name), and daffodil, which are applicable to the whole group. These terms are now used interchangeably and will be so employed here.

An effort has been made to have the word narcissus used without change for the plural, to obviate the use of the awkward Latin (narcissi) and the still more awkward English form (narcissuses). As desirable as this may be, the plan has not been generally adopted. There is really

no uniformity of usage, but the Latin plural seems to be the preferred form. In this publication both plural forms are avoided.

The *Narcissus* belongs to the Amaryllis family, noted for its wealth of handsome, attractive, and interesting flowers. The members of the genus are characterized by having tunicated bulbs, narrow strap-shaped leaves, white or yellow flowers having six spreading perianth segments and a central crown, cup, corona, or trumpet which varies in shape from that of a saucer to a long tube. Although yellow and white forms prevail, the smaller flowered ones often have a touch of red in their cups. Much effort has been put into accentuating this through breeding, not only in the Poets but in the half-trumpet forms as well.

There is scarcely a group of plants that has received so much attention at the hand of the hybridist or has been so much modified by culture and cross breeding as the daffodil. The commercial forms of a generation ago are not in the same class as those of today. Progress is still rapidly going on. There is plenty of evidence that the next generation will witness still greater transformations, and that the daffodils of the future will eclipse those of the present in about the same ratio as our present forms surpass the old natives of Southern and Western Europe.

The varieties employed are growing progressively better. The change is gradual. The evolutionary process is slow, because it takes 20 years to develop a variety from a single seedling to commercial proportions.

The literature of the daffodil is in a rather unsatisfactory condition. Some one should write a book on this interesting subject, for there is now none available to the average person. A number of excellent books have been written, but they are out of print. It is hoped this bulletin will assist somewhat in making available some of the information that the grower needs.

The grower and the householder are now very largely dependent on the catalogues of tradesmen and on articles in current trade journals. These are excellent as far as they go. Some of the bulb and seed firms issue cultural directions for bulb stocks, including the daffodil.

Secondhand bookstores and dealers may be able at times to furnish copies of the following books:

- Kirby, A. M. *Daffodils, Narcissus and How to Grow Them.* 1907.
- Bourne, Rev. E. S. *The Book of the Daffodil.* 1903.
- Jacob, Rev. Joseph. *Daffodils.* 1911.
- Sydenham, Robert. *All About Daffodils and Narcissi.* 1913.
- Burbidge, F. W., and Baker, J. G. *The Narcissus, Its History and Culture.* 1875.

The last edition of the Classified List of Daffodil Names (1929), published by the Royal Horticultural Society, London, England, is available and can be purchased through any reliable book dealer, or may be ordered direct.¹

BULB CATEGORIES

Every trade and business has its own language. A large part of the work of the student is to learn the language of the profession or trade which he enters. So it is with the daffodil business. It is necessary to learn certain names and a phraseology which has grown up around the business.

There are several stages of development, sizes, and shapes of bulbs in any mass as dug. These have received class names. The line of demarcation between the classes is not always distinct, but the classification is very useful as an aid to descriptions and a clearer understanding of the nature of the plants.

Possibly the easiest starting point is the round bulb, or, as it is sometimes called, the single-nosed bulb. This is round in horizontal circumference and will throw one shoot consisting of a flower stem and three to five leaves the next season. The third year it may be nearly round but have provision for making two shoots, both inclosed in the same outer tunics. It is then referred to as a double-nosed bulb and may or may not give two flowers. The following season the two noses will separate and one or both of the segments may show the double-nosed condition. It is now a mother bulb. There may be a flat-sided section so well separated that it should be taken off and planted independently. This is known as a slab. It will round up in a year and become first a round bulb, then a double-nosed one, and then a mother bulb (fig. 1).

However, while it is convenient to look upon each category as occupying a year to transform into the next, the multiplication, especially in the better commercial varieties, is much faster. The slab may become a double-nosed bulb in one year, and a round bulb may grow into a mother bulb in the same length of time.

THE GENUS NARCISSUS AND ITS DIVISIONS

The group of plants with which we are dealing is an exceedingly large one and is being augmented rapidly by the addition of scores of new seedlings which hybridizers are developing each year.

¹Since this was written there has been published "Daffodil Growing for Pleasure and Profit," by Albert F. Calvert, giving a comprehensive resume of the subject from the British viewpoint.

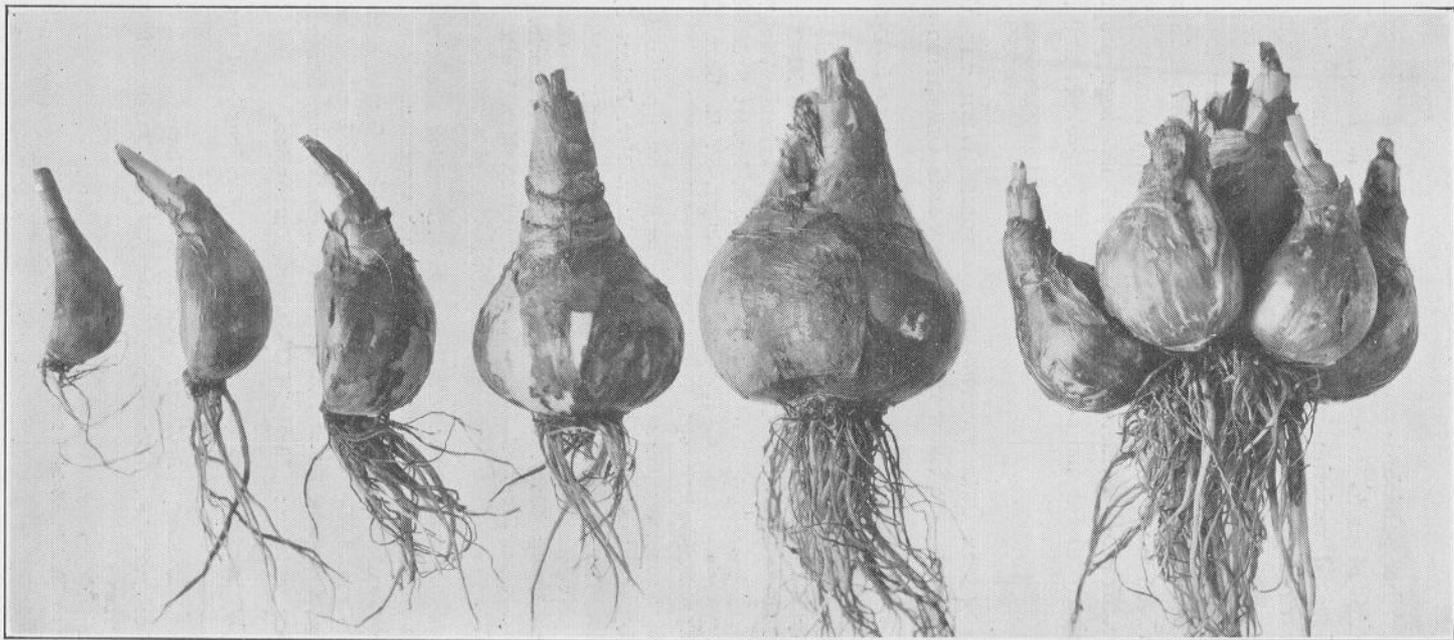


FIG. 1. *Categories of bulbs.* Left to right: Three slabs, round or single-nosed, double-nosed, mother bulb.

The last list published contained about 2,000 names in common use for varieties of daffodils now in cultivation. The list of the more or less antiquated varieties is considerably larger than this. A good collection of daffodils in cultivation will contain about 200 varieties, while the real commercial sorts may not number more than two dozen.

With such a great array of material, it is necessary to have some method of classification that will segregate the varieties into groups. This has been accomplished in a rather satisfactory manner by a classification confessedly artificial but the best that has been proposed. It is exceedingly useful and should be familiar to growers and amateurs alike.

OUTLINE OF THE CLASSIFICATION OF DAFFODILS WITH THE VARIETIES
KNOWN TO GROW IN NORTH CAROLINA CLASSIFIED

Division 1. Trumpet Daffodils: Trumpets as long as or longer than the perianth segments.

- a. Ajax or yellow Trumpets; varieties having yellow, self-colored, or nearly self-colored flowers; Olympia, King Alfred, Minister Talma, Sir Francis Drake, Golden Spur, Trumpet Maximus, Van Waveren's Giant, Plato, Emperor, Mrs. Harry J. Veitch, Robert Sydenham, Lord Roberts, Ball of Gold, Hoboken, Harbinger, P. R. Barr, Cervantes, Trumpet Major, Princeps, Tresserve.
- b. White Trumpets; varieties having trumpets and perianth white or nearly white; Madame de Graaff, Peter Barr, Mrs. Robert Sydenham.
- c. Bicolor Trumpets; varieties having white or nearly white perianth and trumpets some shade of yellow: Edison, Silver Giant, Silver Spur, Spring Glory, Duke of Bedford, Martha, Victoria, Empress, Moneymaker, Glory of Sassenheim, Conqueror, Mrs. Walter T. Ware, Vanilla.

Division 2. Incomparabilis: Chalice-cupped, in which the crown is one-third to less than the length of the perianth segments.

- a. Yellow varieties: Sir Watkin, Golden Frilled, Gloria Mundi, Blackwell, Croesus, Derwin, Coryn, Princess Victoria, Breila, Aled, Berdas, Marigold, Leonie, Beauty, Autocrat, C. J. Backhouse, Sunlight.
- b. Bicolor varieties: Ideal,² Will Scarlet, Bernardino.

Division 3. Barrii: Cup less than one-third the length of the perianth segments.

- a. Yellow varieties: Brilliancy, Glitter, Bath's Flame.
- b. Bicolor varieties: Masterpiece, Lady Moore, Firebrand, Eyebright, Albatross.

² There is an Ideal in Division 9 also.

Division 4. Leedsii: Perianth white with cup white or tinged with yellow or apricot.

a. Cup one-third to less than the length of the perianth segments: Sirdar, Lord Kitchener, Girdle, Crystal Queen.

b. Cup less than one-third the length of the perianth segments: Queen of the North, Evangeline, M. M. de Graaff, White Lady.

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

Division 6. Narcissus cyclamineus hybrids.

Division 7. Narcissus jonquilla hybrids: Buttercup, Campernelle, Odorus Rugulosus, Jonquilla, Golden Sceptre.

Division 8. Narcissus tazetta (Polyanthus) and its hybrids: Grand Monarque, Grand Soleil d'Or, Paperwhite, Triumph, Laurens Koster, Lucrece, Orange Cup, Elvira, White Pearl, Grand Primo, Jaune Supreme, Gloriosa, Mont Cenis, Lord Channing, Bathurst, Newton, Scilly White.

Division 9. Narcissus Poeticus varieties: Laureate, Glory, Glory of Lisse, Ornatus, Dante, Horace, Epic, Almira, Thelma.

Division 10. Double varieties of all groups. Butter & Eggs, Sulphur Phoenix, Semi Plenus, Dubloon, Double Sir Watkin, Double Campernelle, Double Van Sion.

Division 11. Various botanical species.

SOIL PREPARATION

To grow daffodils well, the soil must be thoroughly and deeply prepared. The bases of the bulbs are set not less than 6 and better 8 inches deep, and the roots ramify fully 12 inches deeper if they find congenial conditions. The minimum depth of culture for best results should therefore be about 18 inches. Of course, good results may be obtained with shallower tillage, and it is seldom that an 18-inch depth of soil stirring by any means is practicable in our habitually shallowly prepared lands for a number of years. Nevertheless, such depth should be attained as soon as practicable. A good plan is to plow a little deeper each year and make liberal use of a subsoiler 6 inches or more below the plowsole at each plowing, thus causing some mixing of the surface with the subsoil and loosening up the latter.

The soil should also be loose and friable, for the bulbs can not develop properly in size and number in hard, compacted ground. With deep plowing and spike-tooth harrowing, soil suitable for best results in narcissus production should be in condition for planting. Whatever work is done on the land after plowing is best performed with horses, for a tractor over plowed ground packs it too much.

Fortunately, deep culture and thorough tilth are not difficult to attain in most of the Coastal Plain section. The soils are mostly sandy

loams, admirably adapted to the system and condition of tillage necessary for good bulb crops.

It should not be understood that the bulbs can not be successfully grown on heavy soils. They grow very well on sandy loams and heavy clays, but the latter should be made friable for best results. Bulbs neither attain a desirable size nor divide as well in compacted soils.

FERTILITY

Daffodil culture is an intensive job. Cropping is heavy; consequently, the amount of plant food in the soil must be relatively greater than for lighter cropping of farm crops as ordinarily grown. To obtain this concentration of plant food in the soil without the employment of raw manures should be the constant aim of the grower. In order to attain the end, he must be able to see ahead, as it were, for three years in order to visualize the correct balance of his operations.

Animal manures are certainly the best fertilizers for daffodil culture when correctly employed, but the grower who uses them must be experienced in their handling. Probably the best short rule that can be given for their proper use is to apply them to the previous crop and grow daffodils on the residue supplemented with commercial fertilizers. A heavy application of manure, with a hoed crop intervening before the daffodils are planted, is an excellent practice. An application of manure before a cover crop to be turned under a month or six weeks before the bulbs are planted is also strongly recommended.

There is a great deal of difference in the effect of manure from different sources. Raw, poorly incorporated horse manure is particularly deleterious to the bulbs which happen to come in, or nearly in, contact with it. Basal rots are almost certain to follow its use. If a choice is offered, cow manure is much safer, but even this, used in the raw state in the quantities necessary, is often likely to cause injury when mixed with the soil at planting time.

Cover crops are particularly well adapted for putting soil in condition for planting, although it is difficult to incorporate enough plant food by this means alone to raise a large crop of daffodil bulbs. Rye and oats as winter crops and cowpeas and soy beans for the summer are particularly well adapted to North Carolina conditions.

Of more importance possibly than any of the above in North Carolina are the chemical or commercial fertilizers. The use of chemicals has not yet crystallized into any general practice in this country, nor has there been sufficient experience under conditions existing in this State to warrant more than general statements. A few facts seem to

be well established, however, and experiences at Willard seem to indicate the possibilities of a high-grade fertilizer with the nitrogen derived in part at least from organic sources. A mixture containing 4 per cent nitrogen, 8 per cent phosphoric acid, and 10 per cent potash, applied at the rate of 1,200 to 1,500 pounds to the acre at planting time, supplemented with 200 pounds of sulphate of ammonia in early spring, seems to be indicated by the investigation. This has been in addition to one or two cover crops turned under.

More experience is necessary to develop a reason for a preference for the sulphate of potash over the muriate of potash, so largely employed and recommended. The use of ammonium sulphate rather than nitrate of soda is more definite in the minds of the authors for the reason that it is slower in its action.

For daffodil culture in North Carolina dependence will doubtless be placed on cover crops supplemented with commercial fertilizers. This seems to be most practical and in keeping with other horticultural practices. Many factors are yet unsolved. It is not known what is the most economical dosage, or whether two lighter applications would be more or less efficacious than one. The fertilizer practices with Irish potatoes can be accepted as a fairly accurate guide for daffodils.

USE OF LIME

It is believed that North Carolina soils in their natural condition are well adapted to daffodil culture without the use of lime. The experimental cultures detailed here were initiated on land two years removed from the forest, with no lime applied in any form. The crop is supposedly adaptable to soils having slight acidity.

PLANTING

The methods used in setting daffodils in the field are infinitely varied. There is little reason for describing more than one or two that are now employed in the State.

To receive serious consideration, a method of planting must fit into a suitable method of digging. It is a simple matter to plant, but to plant in such a way that the bulbs can be advantageously dug is quite a different undertaking.

In the investigations at the Coastal Plain Station the bulbs have been invariably plowed in. A furrow is made with a 12-inch plow crowded to cut about 15 inches. The hitch is set so that the mule walks on the land. (Pl. 1, A and B.) Generally, but not always, a hand rake is drawn along the lower part of the furrow slice to bring



PLATE 1. A—Planting daffodils at the Coastal Plain Station, Willard, N. C.

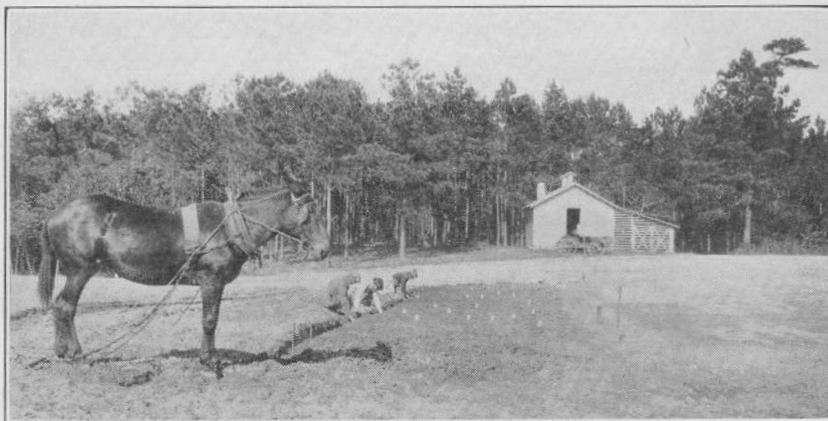


PLATE 1. B—Another view of the daffodill planting, showing the bulb-storage facilities.

down a little of the fresh, loose soil, and a line is stretched to guide the bulb setters. Commonly, both raking and lining may be dispensed with and the bulbs simply set sufficiently accurate in the lower edge of the furrow slice without a guide, but straight rows aid cultivation and prevent damage to foliage while cultivating.

The plot to be planted is plowed all one way. A row is set, then the next furrow covers it and opens up a place for setting another row. The bulbs are thus set in each furrow and in rows 15 inches apart.

In this method of planting the plow must be dragged back empty. Some time in the future implement manufacturers may construct a reversible plow which will be better adapted to the purpose of throwing the soil one way. The present sidehill plow does not cover well enough. Of course, it is perfectly feasible to plow the ground to be planted in lands if one is willing to have a back and dead furrow in each. This has no great disadvantage, and would enable the employment of two crews setting bulbs. The method is applicable where the plantings of one variety are large. It has been less applicable in our plantings of comparatively small lots of a large number of experimental varieties.

Some growers plant in either single or double rows $2\frac{1}{2}$ or 3 feet apart. In such cases the furrows for the reception of the bulbs are opened with a middle breaker. The covering is done with a tool which throws the soil into ridges over the bulbs, for in this method of planting it is necessary to keep the position of the rows well marked to accommodate fall cultivation before the bulbs are up. At the Coastal Plain Station the single rows, 15 inches apart, have been satisfactory and have furnished a method for digging that thus far has seemed to be the most satisfactory that we have been able to work out.

At the Coastal Plain Station bulbs are planted around the first of October. It is important to withhold planting until the soil becomes cool. After that, generally speaking, the sooner the bulbs are planted the better. However, certain varieties tend to grow and bloom so early that they may be damaged by cold weather. The time of blooming can be somewhat regulated by the time of planting. Storage temperatures will also affect the time of flowering and, therefore, the time of planting.

DENSITY AND DEPTH OF THE PLANTING

Large bulbs have usually been set about three to the foot. Large mother bulbs (fig. 1) of such varieties as King Alfred, Plato, and Empress often need to be set but two to the foot, while smaller sizes may be set as close as four to six to the foot. In a planting of this kind, large round bulbs set three to the foot in 15-inch rows, there will be

nearly 100,000 to the acre. The same distance apart in 3-foot single rows will take but 26,000 to the acre, and double rows 3 feet on centers will take 52,000 to the acre. In the experience of the authors the thicker planting seems to possess the most advantages, since there is greater economy of space, fertilizer, and labor.

Preferably, all bulbs should be set upright, which is a simple operation in our loose, loamy soils if properly prepared. With all of the large-bulbed varieties, such as King Alfred, Van Waveren's Giant, Emperor, Plato, etc., there is no occasion for anything but a set-up bulb. However, with the splits or slabs of small-bulbed varieties, such as Ornatus, Horace, such Barrii varieties as Early Surprise and Lady Moore, it is permissible to strew them along the rows in any position they happen to fall. When very small, they may be put in as thickly as one to the inch.

The authors are of the opinion that there is greater danger of too shallow than too deep planting. In general, 4 inches of settled soil over the tops of the bulbs is about right. Deeper planting in light and shallower planting in heavy soil is advisable.

Depth of planting has some influence on the splitting of the bulbs. Other conditions being equal, shallow-planted bulbs are likely to split more than deep-planted ones. Theoretically, therefore, the mother bulbs, which are the propagators, will give a greater number of offspring if planted shallow. This practice has been advised by some, and it is said that the culture in some foreign lands is so nicely adjusted that a distinction is made in the depth of setting of bulbs planted for increase of stock and those planted to be marketed at the next digging. The authors, however, have not found it practicable to make any distinction in the depth of planting of different categories of bulbs. Almost invariably the plantings have been deeper than the conventional 4 inches. They have varied from 4 to 6 inches and have yielded satisfactory results. There has been a satisfactory splitting and no undue separations in the double-nosed bulbs.

There is another reason for good covering of soil over the bulbs. An added inch of earth over them is a very great factor in unifying the temperature. The protection of the bulbs in the winter may not be so important in this State as it is farther north, but a deep setting in our light soils is not without its protective value in an occasional cold winter, such as was experienced in 1927-28. There is, however, a very decided benefit from a heavy covering of soil under our conditions in April to June. One of our handicaps in daffodil culture results from occasional high temperatures and at times droughty conditions during the last two months of growth. The practice of rather deep planting

and level culture has decided advantages in protecting the bulbs from heat and drought. On the other hand, it has been noted that shallow planting, especially if the bulbs are set on a ridge, seems to permit them to become overheated in the soil, thus causing loss from rotting in the ground or subsequently in storage. Deep-planted bulbs can be more safely left in the ground over summer.

One of the important considerations in daffodil planting is the matter of surface drainage. It is highly important when preparing land for bulbs to get it thoroughly leveled so that there will be no wet spots and it might be necessary in low places to have ditches of more or less depth around the bulb planting in order to lower the water table below the depth at which bulbs are planted. In planting bulbs deep rather than shallow it should be borne in mind that the bulbs will not tolerate standing water.

CULTIVATION

There are two distinct periods when a daffodil planting needs cultivation, and they are separated by the dormant winter season when the weeds also are relatively dormant in this climate. The cultivation during both periods is almost, if not entirely, for the purpose of killing these weeds.

If the plantings are in 15-inch rows, as preferred by the authors, cultivation will be done with a wheel hoe or possibly a hand tractor. If the latter is used to any appreciable extent, however, it is certain to pack the ground more than is desirable. Cultivation done before the crop comes through the ground may be in any direction over the surface, but after there is growth near the surface or above ground the rows must be followed for obvious reasons. With a judicious selection of the proper attachments for the wheel hoe, little or no hand weeding is necessary. The weeder knives, the prong scratcher or rake, and the 3-tooth or 5-tooth attachments are those most commonly used. One of these, run between the rows as often as weeds come up, gives all the cultivation necessary.

When the wide rows are employed for horse-drawn cultivators, a slight ridge is usually made above them to keep their position visible so that the tools can be operated without the danger of the horse walking on the bulbs. This causes some trouble at times on account of packing and is but one objection to the use of animals on the bulb beds. Nearly all experienced bulb growers fear the employment of horses on bulb plantings on account of the injury done when the animal steps on or too close to the bulbs. For similar reasons, the continuous employment of hand tractors is not satisfactory because they compact

the soil to a greater depth than the tools can penetrate. Any packing of the soil in daffodil culture should be avoided as much as possible. Doubtless one of the important advantages of the Dutch system of culture is due to the paths between the beds being used for all of the work done. No foot ever falls on the planted area.

ROGUING

Mixtures are prone to occur in daffodil culture as in all other bulb plantings. The stray bulbs can be taken out with greatest certainty when in blossom and this should be attended to each year. The best tool for this work is a strong spud. A blacksmith can make one out of an old automobile spring inserted through a ferrule into a strong handle. This is thrust into the soil beside the bulb and pried a little to loosen the soil and break the roots, when the bulb can be taken out readily. A narrow tiling spade is also a useful tool for roguing.

In commercial culture such rogues usually are discarded. If considered worth while, they may be heeled in to ripen and then included with the varieties to which they belong to be grown to commercial quality the next year, or they may be thrown into the cheapest mixtures.

REMOVING FLOWERS

The general advice from experienced bulb growers is to remove the flowers of daffodils as they fade. This is not so difficult as it at first appears. The flowers are simply pulled off by passing the fingers on each side of the stem just below the flowers. A slight pull snaps the stem just below the ovary. When the flowers are removed they are placed in containers and taken out of the field.

The object in doing this is twofold. The development of the bulb is accelerated by preventing seed production. The flowers decaying on the plants are likely to mold and spread and encourage the development of fire blight, causing the leaves to die down before they should.

Under our Coastal Plain conditions, fire blight is not likely to be a factor except possibly close to the coast. With normally thick planting in 15-inch rows no premature ripening due to *Botrytis* has occurred such as happens in humid regions with a lower mean temperature.

Again, the seed production is not great, much less than in the Pacific Northwest; consequently, the need for flower removal here is less than in other regions. A distinction should be made between different varieties in the matter of flower removal. The long Trumpets and the large-flowered *Incomparabilis* forms especially require it. Few growers trouble themselves to remove the flowers of the *Barriis*, *Poets*, or any

but the larger flowered Trumpets. Some of the Polyanthus group, especially the Paperwhite, make large quantities of seed in Florida and the flowers have to be removed, but seldom is a pod of seed seen in this State.

DIGGING

The lifting of the crop from a 15-inch row planting is very simple. The same plow used in the planting, or one a size larger, and two mules can be advantageously employed. The operation consists of simply running the plow below the bulbs and between the rows. The roots are there in plain sight in the furrow slice, and the bulbs can be readily picked up, placed in containers, and taken from the field. Much less injury is done by this method than by any method of hand digging that has been employed, and no machine yet seen can compare with it in its protection of the stocks. The plan is most satisfactory, however, when the planting is in 12-inch to 16-inch rows, enabling all the land to be plowed with a row of bulbs in each furrow slice.

The plowman can do a great deal to simplify the gathering of the bulbs by so plowing that the row is on the outer edge of the furrow. The bulbs will then be elevated to the top of the furrow slice. Strong, steady mules are much to be preferred for this work. A double row, such as is planted by some, may be barred off and then plowed out. The plan works rather satisfactorily, but it is much more difficult to pick up the bulbs and more are likely to be missed.

FREQUENCY OF DIGGING

The daffodil grower who has his stock up and is selling regularly year after year seldom leaves his bulbs undug. In order to get first-class merchantable bulbs it is necessary to move and redistribute them every year so that each one may have sufficient feeding space to make maximum growth. Stocks left undug become crowded, less shapely, and do not fit so well into the commercial categories as those set each season.

While the grower is working up stock, and in cases where small bulbs are planted from which no sales are to be made, the bulbs can often be profitably left undug one or more seasons. Such practice insures a good lot of planting stock.

In the relatively warm climate of North Carolina the bulb beds left undug over summer should always receive special treatment in the way of protection. Cowpeas or soy beans may be drilled in between the rows at the last cultivation about the middle of May. These will cover fairly well by the time the daffodil tops die down, thus

smothering weed growth. The dormant bulbs suffer in bare, hot, wet soil in the long summers from June to September, and they must not be left unprotected. The crop of peas or beans not only shades the soil but reduces its moisture content as well.

There is little uniformity in the handling of such a crop in the autumn. Sometimes it is mowed off; at other times it is allowed to die down, disintegrate, and be worked into the soil the following spring; or the grower may elect to remove the old stems only after a frost. At best, the process is a messy one and not entirely satisfactory. It is not at all certain but annual digging may be more economical under all circumstances except in naturalized settings, border plantings, or other conditions where the production of merchantable bulbs is not the primary business.

STORAGE

The digging of daffodils in North Carolina is done about the first of June. The bulbs must then be stored until September. This storage period is a very important one under our conditions; indeed, the success

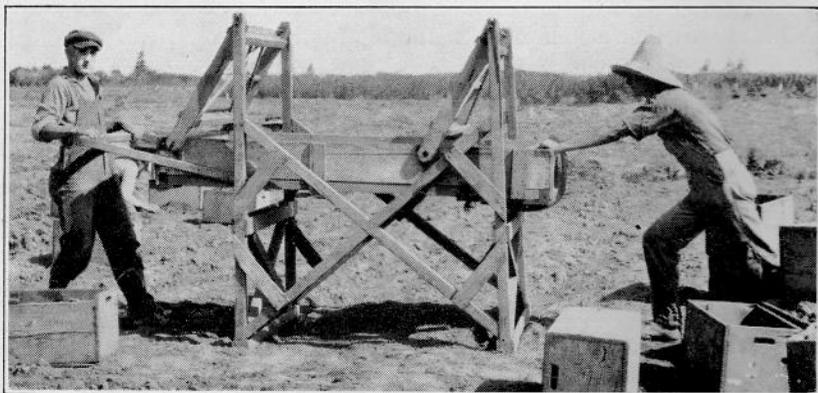


FIG. 2. A form of shaker commonly used to remove soil from bulbs.

of the daffodil business is contingent upon the keeping quality of the bulbs during this period, which is often erroneously considered a dormant one.

How and under what conditions are the bulbs to be held that there may be no deterioration? The answer to this question can not yet be given with any degree of finality, but the problem is being investigated. Provisions are being made for storage under sufficiently varied conditions to determine whether it is possible to store in our warm climate as successfully as in a cooler one. A report will be made on this later. For the present it is possible to report on methods of handling

and to describe what has taken place under the conditions of storage heretofore employed.

The bulbs, plowed out as described elsewhere, are picked up out of the furrow slice and put in baskets to be taken out of the field. A large amount of soil often clings to the bulbs under certain conditions. Most of this is shaken off by hand as the bulbs go into the containers, but no effort is made to get the bulbs clean. To do this would require screening them over a wire screen, as is done almost invariably in cool regions. (Fig. 2.) This rough treatment is not considered permissible in our warm climate. The bulbs are, therefore, taken to storage quite dirty, dried there, and cleaned later. The quicker the surface moisture can be dried off the better, and under no consideration should the bulbs be allowed to remain in piles. The ideal way is to pour the bulbs without bruising on to the shelves in thin layers where there is good aeration until thoroughly surface dried. They can then be piled up more if necessary.

Our experimental stocks have been placed on trays in a structure which may be described as the most approved type of sweet-potato house. (Pl. 1, B.) The ventilators in the four corners in the floor and the two in the roof have been constantly open, while the remainder of the openings were closed continuously during the entire summer after the first two or three days.

This form of storage is a very expensive one and seems to possess no advantage for daffodils. The authors are inclined to think that the open shed with wide projecting eaves, with or without latticed walls, is the best form of storage for our conditions unless underground or artificially cooled storage methods now being investigated are eventually found more practicable.

The bulbs are spread in thin layers on trays which fit into stationary racks. A convenient arrangement is to have the trays slide into place about 9 inches apart. The trays may be about 24 by 36 inches and handled by one man, or if larger, by two men. In lieu of the trays, stationary shelves are more commonly employed to hold the bulbs. These can not well be placed closer than 15 inches apart. They are not convenient if more than $2\frac{1}{2}$ to 3 feet wide. Such an arrangement of shelves can not be loaded from baskets or lug boxes, but a large scoop such as is illustrated in Figure 3 is required. To unload the shelves another form of scoop similar to that formerly used by the grocer may be employed.

Storage in slatted crates holding about one bushel, stacked in an open shed, has also been tried but the method is not to be commended. There is not a free enough circulation of air in the interior of the mass. Slight heating and consequent deterioration result.

Trays may also be stacked without racks. This method is more economical of space and is well adapted to commercial culture where large quantities and few varieties are grown. The trays may be made to stack crisscross or they may be built with blocks under the corners, to be piled straight, one on top of the other, as high as can be reached.

There is much variation and difference of opinion regarding the kind of bottom best suited for the trays. Many growers make the bottoms of lath slightly spaced, others prefer tight bottoms, while still others prefer about a 3-8-inch mesh of wire. There is little doubt that the aerated bottom tray is best for the daffodil in our climate, although a solid bottom may be required for some other stocks. Whatever the form of the ventilation, the openings must be small enough to prevent the smallest bulbs passing through.

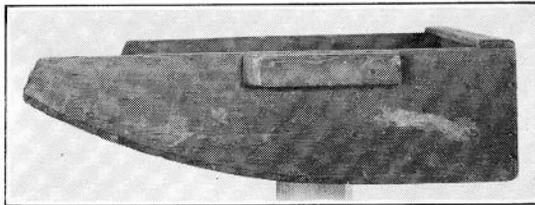


FIG. 3. A convenient scoop for transferring bulbs from baskets or lug boxes to permanent close-set shelves.

The bulbs should be taken out of the sun without delay, dried off promptly, and stored in as cool and airy a place as possible. These are the prime requisites for good storage. Controlling the temperature is the greatest difficulty and is the crux of daffodil culture in our warm climate. An open or latticed shed that is well placed with reference to shade during the hottest part of the day is the cheapest and most efficient aboveground natural place to keep the stocks over summer.

CLEANING AND SIZING

At the close of the storage season, or some time after the bulbs have lain in storage long enough to have become thoroughly dried, they must be cleaned and sized.

Cleaning of daffodil bulbs is usually done by rolling them over a wire screen of 3-8-inch or 1-2-inch mesh. One way is to construct a box 4 to 6 inches deep, 24 to 30 inches wide, and 6 feet long, with the screen for its bottom. This box may be mounted in a frame, allowing oscillation as illustrated in Figure 2, hence the name "shaker." About 10 inches from one end the screen terminates at a movable partition, beyond which a tube of cloth is fastened so that the bushel of bulbs

from the shaker may be dropped automatically into the lug baskets.

The screen-bottomed box may be balanced on a piece of 1-inch pipe supported on two stakes. Raising and lowering the end, thus causing the bulbs to roll from one end to the other, gives sufficient abrasion to remove all the soil.

In our experimental work a much smaller box or tray has been employed. The bulbs are rolled over the screen by hand, or the tray has been shaken by hand.

In cool regions this cleaning is done when the bulbs are brought from the field. However, in a climate such as ours, the very slight abrasion which the bulbs receive in being handled at digging time over the screen is often sufficient to induce rotting. While such a screening is perfectly safe later in the season, and especially after the first of September when the circle of roots has begun to bulge, it is fraught with great risk when the bulbs are first dug. It is much safer to dry the bulbs thoroughly before they are subjected to any more handling than is absolutely necessary.

Sizing goes hand in hand with the cleaning. For moderate lots of bulbs handwork is satisfactory, but for quantity performance various machines are employed. One type of these consists principally of graduated gratings of parallel bars. Foreign machines are built in the form of a drum having sections of its sides perforated on much the same principle as the ordinary gravel sizer. Sometimes in large establishments the bulbs are caused to travel over a wide belt, along which are stationed workers with nimble fingers to do the sizing.

Unlike tulips, daffodil bulbs do not lend themselves well to mechanical sizing; consequently, a large part of the operation is done quite expediently by men or women stationed around a commodious table to which the bulbs are brought in lug boxes or baskets. The workers can easily and rapidly pick out the mother, double-nosed, and round bulbs, leaving the remainder on the table to be shoveled up when sufficiently accumulated and taken to the sizing machine if the grower practices close sizing. These and the mother bulbs are then planted, together with such a percentage of the round and double-nosed as is decided upon.

At the same time a certain amount of separating of clumps is also done. There is always more or less of this necessary, but the general tendency is to carry it too far. It is far better to plant large clumps (mother bulbs) than to break the slabs, leaving large, ugly wounds in the basal plate. Such breaking, done early in the storage season, is prone to cause more rotting than it is after the bulbs have dried and the root ring begins to show action. For this reason it is preferred in our

climate to handle stocks for cleaning and sizing late rather than too soon after digging. If the slabs are to be broken off and planted separately, this can be most safely done just before planting time.

The small bulbs shoveled from the tables, as heretofore described, if taken to a sizer are put in at the upper end of the incline and rolled over the gratings by hand one after the other. The dirt and débris go into the compartments with the smaller sized bulbs, leaving the other sizes clean. The small size must be picked over or put through a grain fanning mill, to remove the débris.

In large operations some such procedure as that described is followed, but in smaller operations separation by hand into two or at most three categories is sufficient, it being easier to separate the resulting size after the next digging than to make many sizes for planting.

THE "DORMANT SEASON"

It is customary to speak of the season when the bulbs are out of the soil as the dormant one, but this is largely a term of convenience and does not express the facts. It is true that the bulbs are dormant in outward appearances, but there are profound changes taking place within them all summer.

If a freshly dug bulb be cut open lengthwise through the exact center, it will be seen to be made up of concentric layers of bulb scales, and no flower will be in evidence. A month or six weeks later a flower can usually be detected by the unaided eye. Before the planting season, especially if planting is delayed, the flower may be a half inch or more long, and well-developed leaves will flank its sides. All of these changes take place in storage; all the more reason, then, why suitable conditions should obtain for these as well as other life processes.

YIELDS

Because there are so many factors involved and the methods of bulb culture are so variable, a statement of yields under our conditions would scarcely be profitable. So much depends on the method of planting adopted that yields must be predicated upon such methods.

The relative increase of bulbs varies greatly in the different varieties. When all are planted back, the increase by weight in most of the vigorous commercial sorts should be about double each year. However, when a large percentage of the largest round and double-nosed bulbs are sold, the relative increase is much less, depending upon the percentage of bulbs turned off, but usually a 50 to 75 per cent increase is to be expected.

In the method of planting adopted at the Coastal Plain Station very close to 100,000 full-sized bulbs are planted to the acre. This is on the basis of a 15-inch row and three bulbs to the foot. Of course, such an assumption is theoretical for a large number of small bulbs are always put in. On the same basis, a planting in 3-foot rows would be fully occupied by 40,000 bulbs.

HOW DAFFODIL VARIETIES ORIGINATE AND INCREASE

All modern varieties of garden daffodils had their origin in a batch of seedlings, sometimes many, sometimes a few, but never has more than one seedling been used as a basis from which stock of a variety was grown up. At the end of the first growing season the seed has been transformed into a bulblet scarcely as large as a pea. For the next three years it may not resemble a bulb in shape, for it will elongate

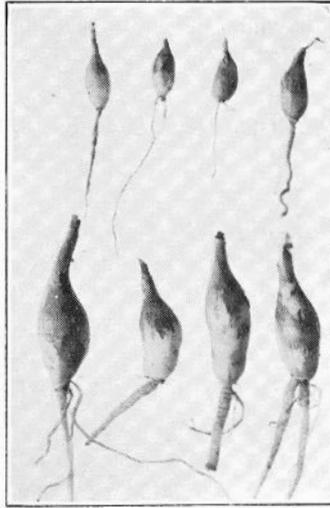


FIG. 4. Daffodil seedlings: Lower, *Glory of Noordwijk*, 2 years old and 4 centimeters in circumference; upper, *King Alfred*, 1 year old and about 2 centimeters in circumference.

and finally round up again at a lower depth and assume the shape of a mature round bulb. (Fig. 4.)

The seedling usually will blossom the fifth year if well grown. During the sixth year it may divide into two firmly united bulbs that may have to be grown another year before they can be separated. Subsequently these daughter bulbs split, divide, and separate indefinitely, thus forming more and more bulbs. These processes continue year after year until at the end of 20 years the number of bulbs produced from the seedlings with which we started may reach a million.

After the formation of a full-sized round bulb from a seed, we may assume that in general the round bulb may become a double-nosed one the next year, then a mother bulb from which a slab or two may be removed the following year. These slabs develop into round bulbs and go through the same changes as the seedlings. All increase of stock is by means of this splitting process. Varieties are generally introduced only after considerable stock has been developed in this way. This explains partially why new varieties are so very expensive.

MERCHANTABLE AND PLANTING STOCKS

The general formula for merchandising daffodils is to sell each year one-third of the planted area or one-third of the tonnage harvested. Better than this can be done with some varieties, but the larger Trumpets must be handled very closely on this basis. Even so, the best must not all be sold; indeed, the planting stock should contain the cream of all the bulbs, for it is by planting the best that the future production is improved.

The market demands mainly two classes of bulbs, double-nosed and round. Mothers are also listed, but they are less suitable for forcing than for propagation. Double-nosed and round bulbs are sometimes further divided on the basis of size.

The inexperienced grower and the one with small capital are both prone to oversell. The three merchantable sizes are the ones in demand. There is consequently danger that these be sold too closely. It will then take the grower two years before he has any propagation to speak of. The best mother bulbs especially should be planted back. They are the capital stock, without which the planting is at a standstill, so far as numbers are concerned, for a year or two until the other sizes grow up. A good quota of rounds must also be planted to produce double-nosed bulbs the next year.

The production of the Dutch daffodils would be very much simplified if the market called for round bulbs only, as it does in the Paperwhite. The maintenance of stock would then be easy, for the mother and double-nosed bulbs would take care of that. The authors have no hesitancy in advising growers who are working up stock that there is no surer way than to hold for planting all but the round bulbs.

This plan is really as just as any. The round bulb is produced in one year from a slab and can consequently be sold much cheaper than if grown two years. The consumer knows much more accurately what he is getting, for a properly grown round bulb is certain to give one first-class flower. Indeed, it has been the experience of the writers

that round bulbs of King Alfred grown at the Station blossom 150 per cent. The round bulbs also take less room in the flats.

However, we must take the market as it is, supplying its demands. To do this and keep up stock the grower must plant each year approximately two-thirds of the number of pounds or bushels which he digs. In order to maintain a balance in the merchantable categories, the planting stock must contain a large number of mother bulbs and a sufficient number of round ones to furnish the double-nosed bulbs needed besides the slabs. If it is desired to increase production, the quickest way is to plant double-nosed bulbs to grow into mothers.

There is another element entering in at this point. It is not desirable to keep the same mother bulbs for long periods. There seems to be a certain deterioration from so doing so that it is desirable to grow a new lot of mother bulbs every five to eight years from the slabs or splits, the old mothers being worked off as such or as second-quality double-nosed after their loose slabs are removed. The appearance and the quality of the bulbs are better if this is done, for old mothers grown as such for long periods reach a point where the bases become large and ugly. Therefore, it is advisable to periodically grow new ones from younger bulbs—slabs and rounds.

The merchantable bulb in the Paperwhite, and possibly the majority of the Polyanthus group except the Poetaz,³ is a round, single-nosed bulb grown in one year from a slab. This is the bulb that gives a single flower stem with a large truss of flowers. These round bulbs should measure 13 to 15 centimeters in circumference.

PACKING AND SHIPPING

Daffodils are usually shipped in bulk in slatted crates holding from 1 to 8 bushels. A flat crate which reduces the mass of bulbs so that there is no portion of the pack which is likely to sweat and heat is by far the best form to employ. All crates used today are battened by crosspieces on the outside, so that aeration takes place all around the containers when large numbers of them are stacked.

The thoroughly dried bulbs are put in the containers loose and preferably filled tightly, so that there is as little movement as possible when the crates are ended over. However, it is seldom that a crate arrives full at destination, for it is difficult to make the pack that tight. This is the conventional method of packing. It is more than likely that some modification in the form of pack may be made when our production increases. Possibly some of the commercial containers which are now on the market may be employed. Already some have

³Hybrids between the Polyanthus and Poeticus groups.

used the ordinary bushel basket, others the strawberry crate, while shipping in sacks is not uncommon. The latter are not to be recommended for large shipments, for there is danger of heating. The ordinary citrus crate is satisfactory, but to be safe it must be ironed. Small lots of bulbs are satisfactorily inclosed in paper sacks such as are used by grocers and packed tightly in cartons or suitably sized boxes. Doubtless the time is not far distant when stock houses will carry assorted sizes of strong, tough, perforated paper sacks like those used in other countries. These are excellent for small lots and insure good aeration.

The matter of shipping daffodil bulbs from North Carolina is a comparatively simple one, for it requires but 24 hours to reach the great eastern markets. The forwarding of all but the largest lots can be by express, but even freight arrives in time for perishable products, and there should be no difficulty with daffodils.

CULTURE FOR CUT FLOWERS

The culture of daffodils for cut-flower purposes need not differ essentially from the handling previously described, except that digging may be done much less frequently. The planting may be done in 15-inch rows as before. Cultivation can be done with a wheel hoe, and cowpeas or soy beans may be sown between the rows at the last cultivation, timed to cover at about the maturity of the leaves.

Formerly in North Carolina, culture for cut flowers has been done with old varieties which have been allowed to run to grass under conditions of naturalization. Under such handling the flowers dwindle in size.

Stocks grown for cut flowers should be dug much less frequently than when growing for the bulbs. The writers have had very good success from digging every fourth year with the maintenance of clean culture and cowpeas over the beds in summer, but it is thought that digging every third year is the most satisfactory. The best crops of flowers occur the second and third years, and if well cared for there is but little dwindling in size.

The easily accessible large markets, the need of returns on investments in the early development of the business, and the earliness and adaptability of our season have all contributed to the development of a large cut-flower business in the eastern portion of the State coincident with the development of bulb growing. Naturally, while production was limited this feature was remunerative. How long it will continue profitable can not now be predicted. At present it is an important adjunct of the bulb-growing business.

WEIGHTS AND MEASURES

In the retail, forcing, and commercial trade generally, daffodil bulbs are sold by the dozen, the hundred, or the thousand. If the stock of a variety is limited, or very expensive, a price may be quoted on a single bulb, not infrequently listed at several hundred dollars each. The really commercial varieties, however, are listed by the thousand, a half or a fourth of a thousand taking the thousand rate. Likewise a price is usually quoted on a hundred bulbs, a half or a fourth of a hundred taking the hundred rate. These conditions relate to commercial grades and sizes.

Usually among growers the exchange of bulbs is on the basis of tons or bushels, and the stocks may or may not be sized. Commonly the sale is on the basis of a field run. This plan is much more advantageous, for the reason that all the categories are thus received and the planting becomes balanced from the start.

There appears to be no standard of weights per measure for daffodils. Such standards may in time be adopted, but this should be done only after a carefully conducted series of tests with a comprehensive lot of standard varieties grown under different conditions.

A series of measurements recently made with Van Waveren's Giant, normally grown and considered a fair average for the variety, will be instructive.

One hundred tight, double-nosed bulbs, 17 to 21 centimeters in circumference, weighed 22 pounds.

One hundred round, single-nosed bulbs, 15 to 17 centimeters, weighed $15\frac{1}{2}$ pounds.

One rounded bushel of the double-nosed bulbs weighed 46 pounds. This bushel weight is very close to the average for good-quality, sound bulbs of any size.

Daffodil bulbs are rated in size in centimeters because the metric system of weights and measures is the prevailing and legal form in the main bulb-producing countries of Europe. The measurement is the shortest circumference of the bulb. In practice, bulbs are passed over screens which have graduated perforations, the bulb taking the size of the screen which catches it.

The use of the centimeter may be a little confusing, but all one need remember is that there are $2\frac{1}{2}$ centimeters to an inch. Consequently, multiplying the number of centimeters by 2.5 reduces it to inches; or, multiplying the number of inches by 2.5 gives the number of centimeters. Putting the matter another way, multiplying the number of inches by 5 and dividing the product by 2 gives the equivalent in

centimeters; or, multiplying the number of centimeters by 2 and dividing by 5 gives the equivalent in inches.

ADAPTABILITY OF VARIETIES

In the several years' work at the Coastal Plain Station, the adaptability of varieties has proved to be the most important problem confronting us. It must be remembered that the geographical situation of this State is to some extent far south for the Dutch stocks on which most of our energies have been directed. On the other hand, our occasional low temperatures are rather severe on such tender varieties as have until recently been imported from the mild climate of the South of France. Both of these stocks, the Dutch and South France, are being grown.

Although we are not yet justified in saying that it is not possible to grow both of these categories of daffodils, it is quite probable that one group will succeed much better than the other. Greatest attention has been paid to the Dutch daffodils, as it has been taken for granted that conditions are better adapted to these than to the French group.

Many of the Dutch varieties do not take kindly to warm summers. They may thrive rather satisfactorily until dug, and then they rot in storage. Nothing has been brought out more forcefully in this work than the variance in reaction of different varieties of Dutch stocks to warm weather.

Two varieties generally used in tremendous numbers for forcing have all but disappeared from plantings in this State. Indeed, it is only with extreme difficulty that Golden Spur is maintained by commercial growers, and Victoria has practically disappeared not only with us but with growers generally throughout the warmer portion of the Atlantic Coastal Plain. It was not so long ago when more Golden Spur was forced than all other varieties combined. Rotting in storage is the reason for the disappearance in both cases. These two varieties are so sensitive to warm conditions that they rot somewhat in the field also. However, our stock of Golden Spur suffered comparatively little from rot in 1928.

It is recognized that the Bicolor Trumpets are in general sensitive to our conditions, but there are exceptions. Victoria has been mentioned. Close seconds to it are Martha, Silver Spur, Silver Giant, and Horsfieldii. Spring Glory is no better. On the other hand, Empress has been well-nigh perfect during the past two years, and Glory of Sassenheim has withstood conditions well. Henry Irving has been a bad failure. It rotted in the field and on the shelves and disappeared

in two years. On the other hand, such a recognized weak variety as Minister Talma has withstood the summer without the loss of a single bulb. King Alfred stands up well, but there are always some losses, although not serious, in Van Waveren's Giant. It is a real satisfaction to see such a fine old variety as Gloria Mundi produce bulbs as hard and firm as possible and remain that way to planting time without a single rotted bulb.

After three storage seasons it has been clearly revealed to the authors that one of the important problems of the investigator in the Coastal Plain of North Carolina is to determine what varieties withstand the warm summers in ordinary storage without rotting. Unfortunately, only a beginning has yet been made, but an accumulation of about 100 varieties has now been made and others will be added as rapidly as possible. The tabulation given herewith will indicate the importance of a thorough investigation of all of the possible commercial varieties. We may eventually decide to confine our cultures to varieties resistant to this storage rot. There appear to be plenty of them, and they are well distributed in the different groups.

The Polyanthus group to the extent of a dozen and a half varieties is being grown at the Station but it is too early yet to say much about them. Paperwhite, Grand Soleil d'Or (Pl. 2), Grand Monarque, White Pearl (Pl. 3, B), and Double Roman are frozen to the ground usually once every winter. In spite of this, the character of the bulb produced is surprisingly good. None of these varieties, except Double Roman, suffers from storage rot.

There are two quite popular varieties that need not be considered in Eastern North Carolina, although they grow very well and are not seriously troubled with storage rot. These are Double Van Sion and Alba Plena Odorata. The flowers of the former turn green in all warm countries, and those of the latter fail to open except under cool, humid conditions. Some of the other doubles may also offend by turning green with us, but the trouble is not serious except in Double Van Sion.

REACTION OF VARIETIES TO STORAGE ROT IN 1928

(Figures indicate percentage of rot, less than 1 per cent being ignored.)

Beauty	0
Blackwell	0
Butter and Eggs.....	0
Cervantes	0
C. J. Backhouse.....	0



PLATE 2. Grand Soleil d'Or, one of the finest of the Polyanthus group. The bulbs were grown at the Coastal Plain Station, Willard, N. C., and forced in the greenhouses at the Arlington Experiment Farm, Rosslyn, Va.



PLATE 3. B—White Pearl, a good forcing variety adapted to early January flowering. The bulbs were grown at the Coastal Plain Station, Willard, N. C., and forced in the greenhouses at the Arlington Experiment Farm, Rosslyn, Va. This does not usually make much of an appeal in the field, but it forces well and is a good flower.

Dante	0
Dubloon	0
Duke of Bedford.....	2
Edison	3
Emperor	30
Empress	0
Gloria Mundi	0
Glory	0
Glory of Lisse.....	6
Glory of Sassenheim.....	0
Golden Frilled (Pl. 4.).....	0
Golden Spur	4
Grand Monarque	0
Grand Soleil d'Or.....	0
Ideal (Incomparabilis) (Pl. 6).....	3
Ideal (Incomparabilis)	0
King Alfred	0
Lady Moore	1
Laureate	1
Martha	65
Masterpiece	0
Minister Talma	0
Moneymaker	25
M. M. de Graaff.....	0
Mrs. Walter T. Ware.....	0
Olympia	2
Ornatus	4
Paperwhite	0
Plato	0
P. R. Barr.....	0
Queen of the North.....	0
Semi Plenus	0
Silver Giant	5
Silver Spur	50
Sir Francis Drake (Pl. 7) ⁴	25
Sir Watkin	0
Spring Glory	50
Sulphur Phoenix	0
Thelma	2
Trumpet Maximus	0
Van Waveren's Giant.....	10
Victoria	33

Thorwaldsen rotted so badly in 1927 that it was discontinued, and the small remnant of the stock was sent to the bulb station at Bellingham, Wash.

⁴ Loss much heavier than in 1927.

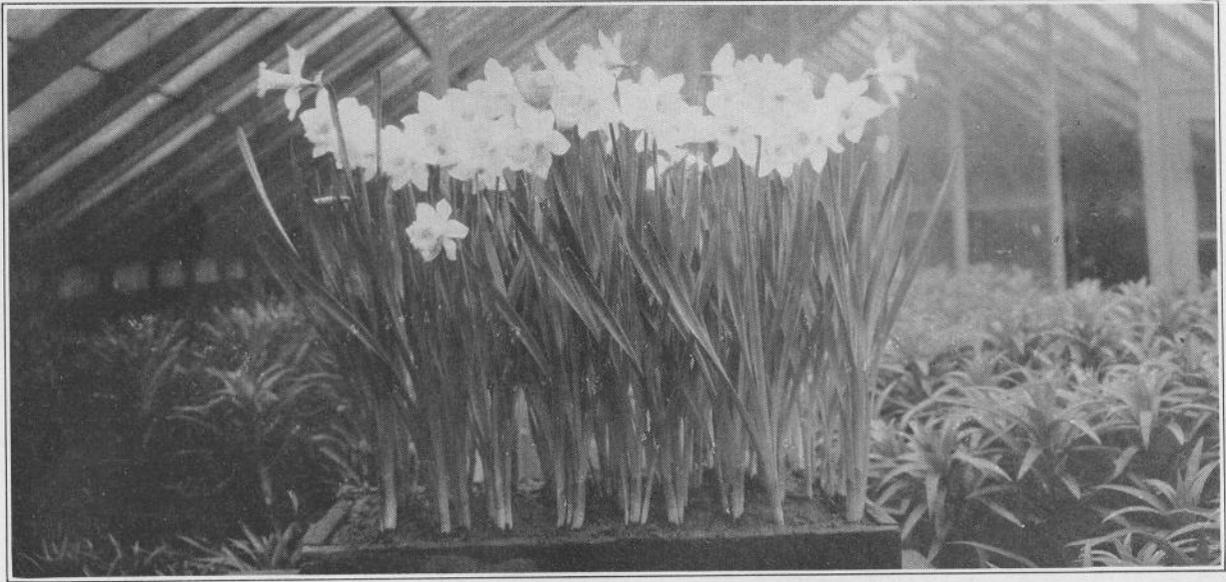


PLATE 3. A—King Alfred, forced in the greenhouses at the Arlington Experiment Farm, Rosslyn, Va., from bulbs grown at the Coastal Plain Station, Willard, N. C.



PLATE 5. King Alfred in the field at the Coastal Plain Station, photographed before the flowers have fully opened.

The bulbs were dug the middle of June and stored two or three deep in shallow trays in a sweet-potato house with the ventilators open. Some of the larger lots, such as Emperor, King Alfred (Pl. 3, A, and Pl. 5), and Van Waveren's Giant were also stored in similar trays in an open shed. So far as could be seen there was no difference in the behavior in the two situations. All bulbs were fairly well dried the first two days after digging before being placed in storage, but a part of the roots are commonly still green. No hand touched the bulbs after they were placed in their permanent positions in storage until planting time the first half of October.

NATURALIZING DAFFODILS

By naturalizing daffodils is meant growing them under noncultivated conditions where grasses and other vegetation are allowed in competition. This may be done on large landed estates, around spacious suburban homes, or in the dooryard of the humblest dwelling.

There are many notable examples of this kind of rather extensive plantings on large estates in North Carolina, but they are almost entirely of old establishment and of varieties which today are little grown. Dooryard plantings are conspicuous in the spring, for it is a rare dwelling but possesses a few clumps of "jonquils" or other varieties, often coming up from soil tramped on nearly all the year.

As already stated, most of the plantings are old and of old varieties. The newer and better kinds are seldom seen. Doubtless this condition will be corrected as growers produce stocks and make them readily available to the buying public.

There are few subjects so adaptable for naturalizing purposes as the daffodil. They may be planted in front of or in partial shade under trees or shrubs, in the wild or the rock garden, on slopes and declivities, on embankments, and beside streams or lakes (Pl. 8). In all such situations they thrive and return many fold in pleasurable aspects for the slight labor taken to establish them. They are especially adapted to open, deciduous forest conditions, for they are fairly well ripened before the shade is too dense.

To produce the most pleasurable aspect with naturalized daffodils, informality is necessary in the arrangement of the planting. No circles, rectangles, straight, or uniform curved lines are usually tolerated. The bulbs are distributed without any detectable plan, thick in some places, thin in others, with always a few scattering beyond the confines of the main setting to insure the impression that no fixed plan has been followed.



PLATE 8. Daffodils naturalized along the brook, Eastern North Carolina.

The planting of the bulbs in naturalizing operations of necessity must be very different from that for commercial culture. Either a spade or a mattock is a suitable tool for planting. The spade blade is thrust into the soil to its full depth, then the handle is pried up and one or two bulbs inserted before it is removed. The mattock blade is thrust in full length, and the setting is done in the same way. A dibble may also be employed, but this requires more labor than either of the other implements.

In any of the aforementioned methods of planting, constant effort should be made to put the bulbs deep enough, 5 to 6 inches to the top of the bulb being none too deep, although this may often be difficult to attain. It is not practicable to set the bulbs upright when either the mattock or the spade is used in planting. They are usually at an angle of about 45° ; indeed, the writers commonly lay the bulbs down flat when establishing naturalized plantings. This method is perfectly satisfactory.

In making pictures with daffodils, for that is really what we are endeavoring to do in landscaping, it is better to keep the varieties separate. If the land is rolling, different slopes may be given over to different varieties. In cases where there is a limited area, or where a long display may be necessary, a careful blend of a late and early variety may be made to insure a long floral display.

When grown in this way with much competition and consequently low fertility, the flowers dwindle a great deal in size and the bulbs become small and crowded. This is more especially true of the large Trumpets than the small Poets; though, as multiplication occurs, a smaller percentage of the bulbs blossom, but commonly, enough of them do to make a beautiful sight for a great many years.

We are often asked the much-mooted question how and when to divide naturalized plantings of narcissus bulbs. The best answer is: "As often as they need it." So much depends on the conditions under which the bulbs are naturalized. The grower should be able to judge by the behavior of the plants. If the growing conditions are poor and the competition great, one resetting in five years may be the most advantageous, but under good fertility the crowding will be much slower. There are plenty examples of old varieties functioning satisfactorily for a dozen years; indeed, a few are known where there has been a satisfactory blossoming for a half century without disturbance, and century periods are not unknown.

The growing of daffodils without cultivation may not be without its commercial aspect; indeed, such handling has often a very important bearing on the general commercial production because of the beneficial

effect on the bulbs. It is recognized that the stocks are benefited by a period of rest from the ordinary annual digging and storing.

In order that stocks may be used in commerce after a period of naturalizing they must be planted without mixtures. The bulbs which have dwindled in size come up again to commercial quality very rapidly under good culture and fertility, and are more vigorous and healthy for the less handling given them.

When grown in grass or open woodland, the foliage should be allowed to mature the same as in other cultures. No mowing of the grass should be done until the leaves are well yellowed. Some varieties withstand early mowing, however, much better than others. Golden Spur is reported to be one of these.

The daffodil may be very appropriately and effectively used in the rock garden and upon rocky declivities, where many species thrive handsomely in pockets of soil between the rocks. For these purposes some prefer the smaller, natural species which unfortunately are not available to the gardener as yet. However, there are plenty of varieties in the *Barrii*, *Poeticus*, and *Leedsii* groups which are now grown in the State and which are eminently adapted to this sort of employment. The large Trumpets may be used in the same way. In the Coastal region the *Polyanthus* or Bunch-flowered group will be particularly well adapted for the purpose.

It seems useless to the writers to recommend any particular list of varieties for naturalizing. There are some doubtless which may not do well under North Carolina conditions, but we do not know what they are. The jonquils, the *Poeticus* group, and the older Trumpets, some Chalice-cups, and *Barrii*s are now well represented but are not nearly as numerously used as they should be.

It is not at all necessary to buy high-priced varieties for planting in grass, for the cheaper sorts often make fully as good a showing in masses. Such sorts as *Conspicuus*, *Mrs. Langtry*, *Madame de Graaff*, *M. M. de Graaff*, *Recurvus*, *Trumpet Major*, *Ornatus*, and *Minnie Hume* are all excellent in their effects. Of course, if one has in mind an investment in planting stocks for commercial production, the naturalized plantings should be made up of the most prominent commercial varieties discussed elsewhere in this bulletin.

In an ornamental planting, particularly in large naturalizing operations, length of floral display is of prime importance. Particular attention should therefore be given to the selection of varieties of early, late, and midseason blossoming. In this way a floral display may be had in our Coastal Plain situation from late February to late April, but not so early in the mountain section.

DAFFODILS ABOUT THE DWELLING

It is not often that one sees daffodils used in bedding; at least, they are much less frequently so employed than tulips or hyacinths. When so used they should be planted thickly, so that the ground may be hidden by the foliage and that there may be a dense mass of flowers. Handled in this way, an effect is produced about as pleasing as with any of the spring-flowering bulbs.

If a permanent bed is made in friable soil, it is very satisfactory to plant the bulbs deep with carpeting plants, such as hardy violets and pansies between, or an interplanting of crocus, glory-of-the-snow, or Siberian squills may be made. Bedding plants may be set with a trowel between the daffodils shortly after they blossom. If properly timed these will occupy the ground fairly well by the time the daffodil leaves are well yellowed and ready to be cut off. The soil may then be lightly cultivated between the bedding plants without touching the bulbs.

Deep setting of the bulbs in such plantings has some decided advantages. The stocks are not only out of the way of cultivation but they may be put deep enough to be untouched by light spadings. They will come up satisfactorily through 10 or 12 inches of sandy-loam soil. Plantings in beds, borders, or other situations will last much longer than when set shallow, for the reason that the multiplication is much less in the deeper settings. Crowding, therefore, takes place much more slowly.

In the vast majority of cases, bedding daffodils are gouged out of the beds at the close of blossoming and discarded to make room for summer bedding plants. This is satisfactory for the householder who can afford it or who has no interest further than the bare enjoyment of the display. It is, however, perfectly feasible to preserve the bulbs. If heeled in a shady, moist situation for three or four weeks until the tops die they may then be taken up and stored in the usual way. If the bulbs planted are first-class, they will blossom quite satisfactorily the second year when handled in this way, but will dwindle in size and be of very poor quality the third. They may be brought back to pristine vigor and quality by a year or two of good field culture.

It is generally conceded that daffodils show up to best advantage when dotted about in clumps or "sown," as it were, in long drifts under conditions where there is a carpet of green verdure about them to furnish a background. Poetical allusions to them in such surroundings and their praises so frequently alluded to in such situations bespeak a more general appreciation of them in a setting of green.

Among and in front of deciduous shrubs they are excellent. Here they may be set quite thick, 6 or 8 inches apart, where they will fur-

nish perennial enjoyment at little or no cost and not crowd for many years, especially if planted deeply. The only danger in such a situation is the temptation to mow the grass before the bulbs are ripe. The daffodils are so far advanced by the time the shrubbery is leaved out that the shade does not seriously affect them.

Daffodils are particularly useful in clumps among perennials. In such places they need not be lifted for years. As the clumps get old and crowd the flowers may be reduced in size, but they will be numerous and yield a wonderfully pleasing display.

A fine utility of space is possible with some of the small, very early ornamentals and daffodils among shrubbery. The snowdrops, Siberian squills, and Virginia cowslips blossom first, then daffodils, and later the shrubs, giving three crops a season with a minimum of attention for years after once being established.

ENEMIES

The daffodil, like most plants, or one might say living things, is beset by a few pests which every grower should be able to recognize. Under present cultural and handling conditions in North Carolina, however, but one of these, the rot, need cause alarm. But since all of them are usually mentioned in connection with narcissus culture, and some are present although easily controlled, it will be well to discuss them briefly.

Greater fly (*Merodon equestris* Fab.): In its destructive state this parasite about half an inch long and one-fourth inch in diameter lives as a large grub in the bulb which it usually inhabits singly and destroys. It is of no consequence in the bulb-growing areas of our Coastal Plain region or similar warm sections. It was imported into our experimental plantings in nearly all varieties up to 1927, but it has entirely disappeared. It is possible that the insect might persist in very limited areas in the high mountains of the western part of the State. The hot-water treatment eliminates it.

Lesser fly (*Eumerus strigatus* Fall.): This fly is only occasionally seen in the State. Like the greater fly, it apparently does not find congenial conditions. Its presence commonly creates unnecessary anxiety. It inhabits putrid bulbs. Those which have decayed from the rot to be discussed later are a fertile field for it. None of it has been seen for two years in any of the plantings at the Station. The hot-water treatment eliminates it.

Bulb mites (*Rhizoglyphus* spp.): These organisms are also rarely seen. They have not been found for two years in the experimental plantings. Hot-water treatment eliminates them also.

Tarsonemus (*Tarsonemus approximatus* Banks, new var.). (Det. by Dr. H. E. Ewing): This aracid, closely related to the cyclamen mite so prevalent in greenhouses, has lately been found prevalent in long cultivated and untreated stocks in the North. It has apparently disappeared from northern stocks brought to the Station. The hot-water treatment destroys it.

Eelworm (*Tylenchus dipsaci* Kühn): This parasite is a very destructive pest of the daffodil, but thanks to the English, Dutch, and recent American investigators, methods have been worked out for combating it which are certain and efficacious. There have been but few cases of infestation by it in the State, and thus far none have been found at the Station. Experience with it has been gained wholly in other sections. The main concern of the grower is to be able to recognize the malady in its inception before the bulbs begin to fail seriously. This is easily done, for once seen it can always be recognized when the plants are in vegetative condition.

In early summer, as the season warms up, after or during the flowering period the leaves of nematode-infested plants become somewhat malformed and develop hard lesions one-fourth inch or more in diameter. When a leaf is drawn between the thumb and forefinger the hard bunches give a very characteristic touch which can scarcely be mistaken when once felt.

Nema-infested bulbs, when dug, may not be essentially different in appearance from healthy ones for several years. It is usually only after some years of infestation that the bulbs start to rot. But any infestation, be it ever so slight, will engulf the stock eventually unless the parasite be eliminated. The one certain remedy is the hot-water treatment discussed on page 47.

Hot-weather rot, Basal rot, Storage rot: This malady, which is scarcely a factor in cool regions, is one of the most serious of our handicaps in daffodil culture in North Carolina and similar sections having warm summers. It manifests itself during the storage season. Bulbs may be perfect in appearance when dug, but soon rot badly, extending to a large percentage of the stock within a few weeks.

Usually, but not always, the rotting starts at the base of the bulb, hence the term basal rot, and progresses upward, leaving the tissues a characteristic purplish-brown color. The color, however, is not peculiar to this rot, for the same reaction occurs in bulbs rotting from other causes. The experimental stocks at the Station at Willard left undisturbed in thin layers on the shelves during the summer, are in a very interesting condition at planting time. In the varieties subject to this trouble, 50 per cent or more of the bulbs may be completely

rotted, while the remainder of the stock is sound and performs normally the next season.

The preventive measures seem to consist in rapid drying in thin layers under good aeration and in as cool condition as possible. It seems certain that rough handling aggravates the trouble and that any accumulation of mass heat is particularly fatal. But even with extreme care, the losses in some varieties are so pronounced from rotting that little, if any, progress can be made in their culture. Such varieties should be avoided until the difficulty is better understood.

Thus far there has been but little difference in the results of storage in a sweet-potato house and a slatted shed, the only methods used at the Station. Provision is now being made for a bank house, and next season some stocks will be put at three temperatures in artificially cooled storage.

It is significant that most of the experimental stocks grown at the Coastal Plain Station are the same as those grown at the Bellingham Bulb Station, Bellingham, Wash. In the latter situation this rot gives no trouble, while some varieties rot here very badly. It is also of importance to note that bulbs thoroughly dried at Bellingham and shipped in crates to the Station in late September keep very satisfactorily for a month or more, whereas those dug here and stored start to rot as soon as dug, and the imported ones rot the next year, this showing the critical period to be the first few weeks after digging.

Stocks naturalized in competition with grass and other vegetation remain in apparently good condition until dug and then start to rot. The stocks at the Station have been left over a season without digging. With a crop of cowpeas over them they passed through the summer in good condition, but some of them rotted considerably as soon as dug the second year.

Investigations are in progress in various portions of the country to determine whether this rot will yield to treatment with fungicides. It is expected that these investigations, together with a study of resistant varieties and with the storage methods now in progress, will go far toward solving this problem of daffodil rot in hot weather. This is not a new problem. Foreign growers have been very familiar with it. The Dutch daffodils grown in the South of France for a single year to induce earliness are said to have rotted in the same way.

The tabulation on page 33 of the percentage of rotting in the sorts with which we have had experience at the Station shows the value of securing readings on as wide a representative list of varieties as possible.

Mosaic, Yellow stripe, Gray disease: These maladies are also imperfectly understood. Some of them seem to be slowly communicable virus diseases; others are probably not. Any irregular distribution of the green coloring matter of leaves is commonly referred to in this country as mosaic. What the trouble is may be of much less interest to the practical grower than how to control it. As with virus trouble in other plants there is but the one remedy, the elimination of the affected individuals. They are dug up and discarded. The best time to do this is in early spring before the daffodils are in blossom. The plants which are off color are gouged out, as described under roguing.

If the stock is mostly "gray" or "striped" all of it should be discarded. It may be forced, but with reduced satisfaction, and then discarded. Some varieties are particularly subject to this trouble also. Golden Spur is rather bad, and Sir Watkin is often worse. Most of the stock of Minister Talma has yellow stripe, and Weardale Perfection has a discoloration accompanied by a roughness of leaf which is particularly characteristic and very different from other forms of blemishes.

As illustrative of the slow communicability of these troubles, the experience of one of the authors in another warm location is to the point. For more than 12 years he has maintained a collection of from 100 to 200 varieties of daffodils, planting about 10 bulbs of a kind in rows 8 inches apart. In the planting there have been several yellow-striped varieties; but in no case has the "disease" been communicated to neighboring varieties, although the planting remained undisturbed four years in one case and seven years in another.

This experience might lead to the conclusion that the trouble is of no importance, but far from it. It is in commercially handled stocks that the greatest damage is done. In such stocks there is a tendency for the bulbs of the affected varieties to accumulate in the planting stock because of the slight dwarfing effect of the malady. In time, therefore, if neglected the stock becomes predominantly striped and of much reduced value. The only remedy is to rogue out the diseased bulbs each season.

HOT-WATER TREATMENT

The process of treating daffodils and other bulbous stocks with hot water is one of the most marvelous pest controls developed in ornamental horticulture in recent years. We are indebted for the invention to Mr. J. K. Ramsbottom in England and Dr. E. Van Slogteren in Holland.

It was worked out to rid the daffodil of the dreaded nema (*Tylenchus dipsaci*), but other important organisms are also eliminated by it, so

that in treating bulbs for nema infestation all other animal enemies are also gotten rid of.

Reduced to its simplest terms, the generally accepted formula for nema control consists of an immersion of the bulbs in water at a temperature of 111° for a period of three hours. It is capable of considerable modification, however, in that an allowable temperature variation of 1° lower or 1° higher is possible. In practice, however, it is advised that the grower employ a temperature of not over 112° .

A variation in the length of time of treatment is also practiced. The official period in this country is $2\frac{1}{2}$ hours from the time the water reaches a temperature of 110° after the immersion of the bulbs. In England and Holland a 3-hour period is advised. The writers prefer a treatment extending over four hours at a temperature of 110 to 111° in all cases of known nematoc infestation.

The apparatus required for administering hot-water treatment consists essentially of a mechanism for maintaining a constant temperature. This is well worked out for other industries, and an application of the thermostatic principles involved has been made for the treatment of the bulbs. Several such applications have been made and several machines have been perfected for treating stocks.

Up to this time but one treating machine has been operated in North Carolina. It is installed in Wilmington by the Coöperative Bulb Growers' Association of that district and is what is usually referred to as the official United States Department of Agriculture machine, illustrated in Plate 9, B. It is thermostatically controlled, maintains a uniform temperature when once adjusted, and is a very efficient unit for treating about one-half ton of bulbs at one time.

The treating machine being installed at the Coastal Plain Station is what is popularly known as the Bellingham bulb sterilizer (Pl. 9, A). Instead of depending on the control of the admission of a constant supply of steam, this machine operates on the thermos-bottle principle. Its parts are a boiler for supplying steam, a wooden tank $2\frac{1}{2}$ inches thick of half-ton capacity, a marine propeller for agitation operated by an electric motor, a muffler for admission of steam, and a needle valve for the control of steam supply.

The parts for this machine can be purchased for about the following figures: Tank, 30 inches wide, 42 inches high, 7 feet long inside, \$50; motor, \$35; propeller and stuffing box \$10; muffler, pipe, and fittings, \$10.

The necessary expenditure for steam is difficult to calculate. Very often a steam supply is available. A good secondhand boiler may be purchased cheaply, or one may be installed which will serve other

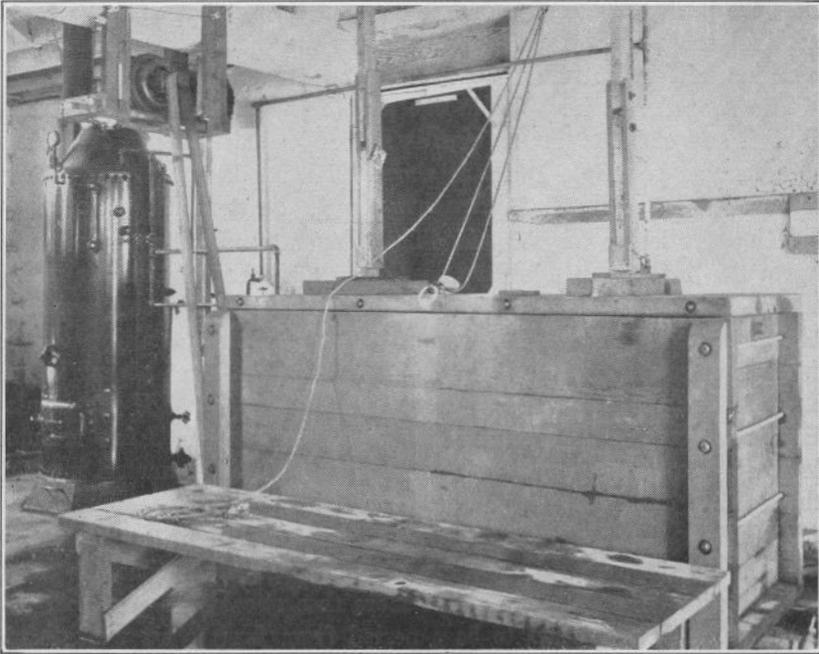


PLATE 9. A—The Bellingham bulb sterilizer being installed at the Coastal Plain Station as operated at the Bellingham Bulb Station.

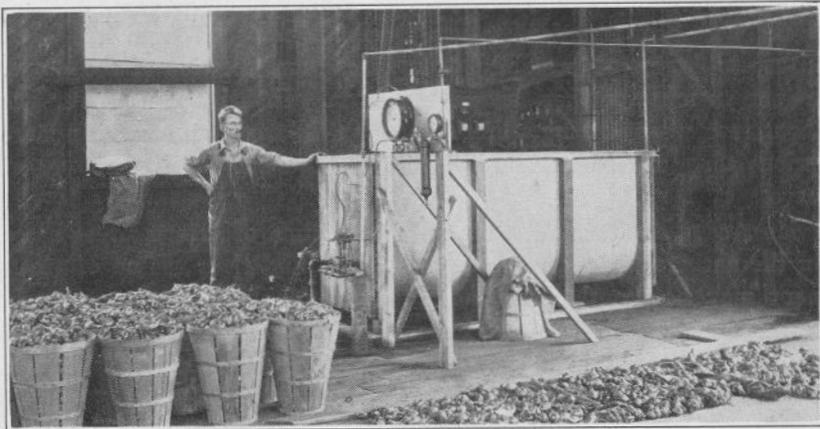


PLATE 9. B—The sterilizer installed at Wilmington by the Bulb Growers' Association.

purposes also. Any man experienced in handling pipe tools can install the parts, or the pipe can be cut and threaded to measure for a nominal charge. Plans and specifications for the construction of this machine will be furnished by the Station upon request.

The propeller is installed in one end of the tank near the bottom. Over it and about 10 inches high is fastened a false bottom of narrow slats leaving an empty space of about 10 inches in the bottom of the tank. The bulbs are loaded in burlap sacks on the false bottom.

The operation is very simple. The temperature of the water is run up to the limit by opening the needle valve on the line leading to the steam chest and held there for 20 to 30 minutes. The steam can then be cut off and the propeller stopped. The machine usually needs no further attention during the remainder of the 3-hour period if the cover is clamped down tightly over a good felt gasket. If the insulation is not good, it may be necessary to admit steam for a few minutes to keep the temperature as recorded by the thermometer inserted through an auger hole in the center of the cover from going below 110° F.

There has been considerable discussion regarding the time the treatment should be given. This is of more theoretical than practical importance. There appears to be a period from four to six weeks after digging when the least injury is done to the flowers. In practice, however, treatment of planting stock is satisfactory for at least a month following a 2-weeks' drying period after digging. Treatment after two weeks of drying is likely to injure the flowers much more than it does two or three weeks later, but such injury is of no great moment to the bulb grower unless he has use for the flowers from his fields. Injury to flowers, or even slight roughening and spotting of the leaves, are not serious for they last but a season. In brief, the grower has about four weeks during which he can safely treat with nothing more serious than malformation of flowers and possibly slight spotting of leaves.

Most of the information regarding the time of treatment is based on the authors' experience in a cool region and their season of treatment may not be the most advantageous for home-grown stocks in North Carolina. There are indications that the most advantageous time for treatment in a warm region may differ somewhat. This is another problem to which our attention will be given.

Of very great importance is the handling of the bulbs after the treatment. They should be thinly spread out in the shade and in as cool a situation as possible until thoroughly dried, for rot is very likely to set in if there is neglect at this time.

It is sometimes advised that the bulbs be planted immediately after the treatment. It is seldom practicable to plant a half ton of bulbs so quickly that no mass heat is generated when the bulbs are left in the containers. Again, it is doubtful whether it is good practice to plant hot, wet bulbs in soil which is likely to be both hot and wet as is ours at planting time.

Varying the treatment according to the size of the bulbs, as sometimes discussed, is looked upon as more or less academic. In practice, all stocks whether large or small will receive the standard treatment. A small split will be heated through in precisely the same time as one of similar dimensions attached to the mother bulb.

It is stoutly maintained by reputable and experienced growers that bulbs benefit from the hot-water treatment beyond the expectation from killing the parasites. Before the discovery of the mite (*Tarsonemus approximatus*), destroyed by the treatment, the elimination of its effects was considered to be one of those residual benefits. Now, of course, this is recognized as a correction of parasitism. But there appear to be still more benefits unaccounted for, so that there is claimed to be an advantage from treatment every three or four years regardless of any recognized parasites. This is a subject requiring further study.

Such treatments are referred to as cultural treatments in contradistinction to those for the correction of parasitism. These cultural treatments differ from the others in both time and temperature. Commonly 105 to 108° F. for two hours is looked upon as adequate cultural treatment and seems to accomplish every purpose of the hot-water bath except killing the nema, with little or no injury to the flowers. Present opinion seems to advise that such treatment be given to planting stocks every three or four years. Of course, in cases where the bulbs are to be shipped interstate, the Federal Quarantine regulations must be complied with. Our experimental stocks have not yet shown need for treatment.

Attention should be directed to the necessity of giving heed to the water in which the bulbs are treated. It should not be used too long, for, although we know of no positive proof that disease is transmitted by the bath, such a possibility exists. The water becomes foul in a short time. The authors have sometimes changed it every other day in a cool climate. This is believed to be the limit of time without change. It is much safer to change daily in our warm climate. If water is used more than one day, much danger can be obviated by having a good head of steam on in the evening as the last batch comes off, and turning it on to heat up to 150° or more during the night. This requires a check to prevent the water being drawn into the boiler as

the steam pressure goes down. Changing the water in the vat may be of considerable practical importance under some circumstances. It takes a large volume to treat the bulbs, and the time necessary to bring it to the required temperature is considerable unless the boiler capacity is proportionately large.

NORTH CAROLINA BULBS UNDER GLASS

The object of forcing daffodils is to bring them into blossom a month or two earlier than they normally blossom out of doors. The constant anxiety of the greenhouse operator is to get the stocks into blossom, and the earlier they come in, as a rule, the better the price they bring on the market.

Stocks grown in North Carolina and the neighboring warm States are mature and ready to dig early and will therefore blossom early. Three years' experience convinces us that such early results can be depended upon with the bulbs produced in the Coastal Plain region.

If digging is done from the middle to the last of June, the stocks are ready to grow vigorously by potting-up time, and the earliest may be in blossom by Christmas or shortly thereafter.

For the past three years the stocks grown at the Coastal Plain Station have been forced in the greenhouses on Arlington Farm, Rosslyn, Va., with perfect satisfaction as to uniformity of growth, floriferousness, and floral quality. They have compared favorably with those grown elsewhere and when handled identically are somewhat earlier than northern-grown bulbs.

The method of handling in forcing has been comparable with that employed in commercial establishments. The bulbs have been flatted up somewhat late, for the most part about the middle of October, and brought into flower the first of February. After being planted the flats and pots have been covered with straw outside for a month or six weeks and then brought into an unheated but frost-free shelter until a top growth of 3 or 4 inches had been attained. Ten days or two weeks under the benches in a house held at 55° F. at night usually brought the flower spike into view, after which the flats were placed on the benches in full light. In three to five weeks longer they blossomed.

Such handling has produced flats as shown in Plates 2, 3, and 7. Thus far it has not been possible to handle our stocks so as to determine the earliest date at which they can be flowered. This is another one of the problems to be worked out, unless it is found that commercial establishments have sufficient demonstrations. The earliest that King

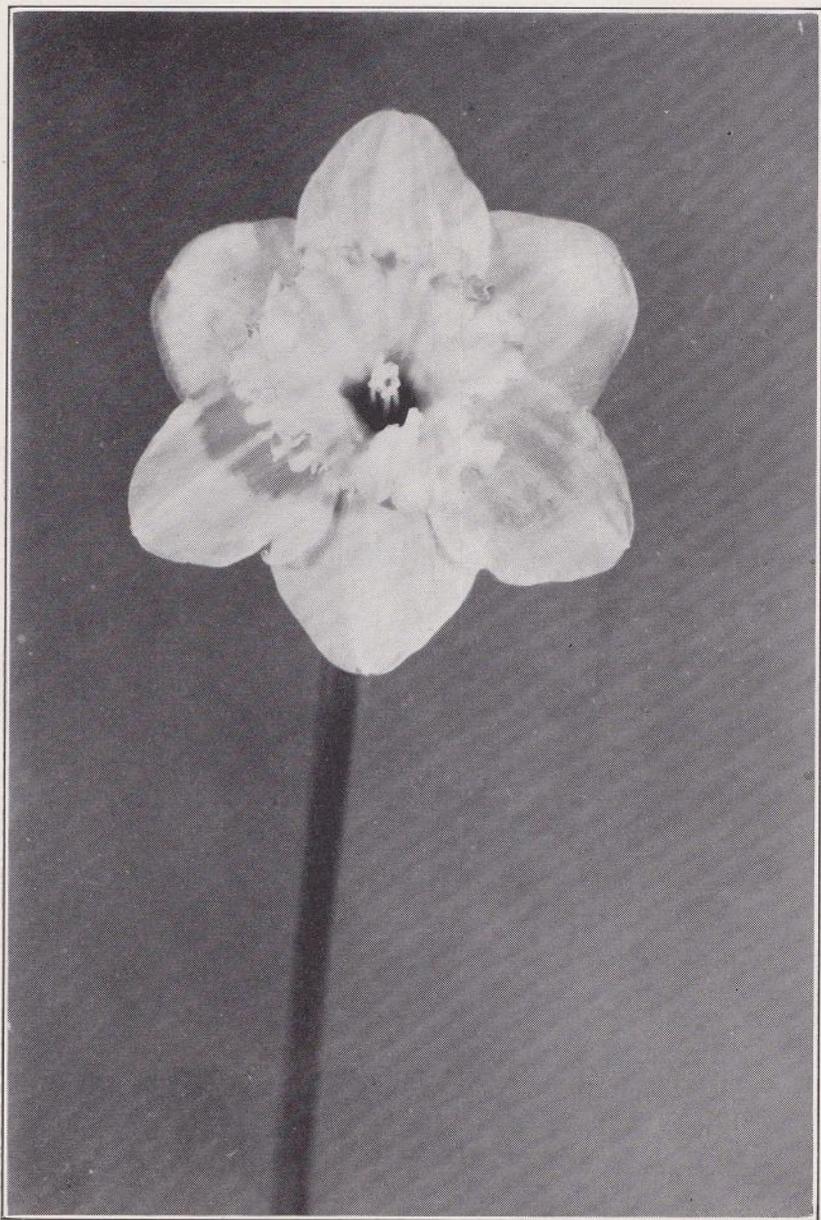


PLATE 4. Golden Frilled, photographed from bulbs grown at the Coastal Plain Station, Willard, N. C., and forced in the greenhouses at the Arlington Experiment Farm, Rosslyn, Va. This is a beautiful variety apparently well adapted to our conditions. Stocks of it are yet scarce and high priced.



PLATE 6. *Incomparabilis Ideal*, photographed from bulbs grown at the Coastal Plain Station and forced in the greenhouses at the Arlington Experiment Farm, Rosslyn, Va. This also is a striking one of the newer varieties not yet abundant. It is necessary to specify the group name when referring to this variety because there is an *Ideal* in the *Poeticus* group also.



PLATE 7. Sir Francis Drake, photographed from bulbs grown at the Coastal Plain Station and forced in the greenhouses at the Arlington Experiment Farm, Rosslyn, Va. This is one of the newer commercial varieties just coming into prominence, but may not be adapted to our conditions.

Alfred has been well flowered thus far is January 8, but this does not indicate the limit of earliness.

CONCLUSION

Although the relatively warm climatic conditions of the State of North Carolina are conducive to storage troubles, these problems do not seem to be beyond solution. It is believed that by the use of adapted varieties and with careful handling of stocks, a means of storage will be developed which will enable us not only to reduce these difficulties to a minimum, but to overcome them entirely. On the other hand, Eastern North Carolina has many advantages as a bulb-growing section, not the least of which is its fine sandy-loam soils. These are mechanically perfect and are easily built up in fertility by the turning under of cover crops. It is possible to turn into the land two legume crops a season, and even three crops can be put in in a single year. Although the climate is relatively warm, it permits the growing of both Dutch and French types of narcissus. It is conducive to early maturity, which in turn means that the bulbs will force early and are therefore of increased market value. The nearness of the district to the large bulb-consuming centers permits marketing the crop under low shipping costs and a minimum of complication from deterioration in transit. While we do not advise general and promiscuous daffodil culture, it is true that this crop fits admirably into the program of diversified farming as practiced in the section. The growers and laborers are adaptable to this type of farming as a result of years of experience in the culture of cannas, tuberoses, caladiums, strawberries, and truck crops.