

The Flower Bulb Industry



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Contents

	Page
INTRODUCTION	
BULBS DO BEST IN COOL CLIMATES	1
BELGIAN ACREAGE HAS FLUCTUATED	3
BERMUDA HAS DECLINED	3
CANADA'S BULB INDUSTRY EXPANDED	3
FRANCE BUYS MORE THAN SHE SELLS	5
JAPAN REENTERS WORLD MARKET	6
MOST DUTCH FARMS ARE SMALL	9
Auctions are unique	13
Many Dutch problems resemble ours	14
Holland's growers unite	15
Trade barriers affect flower exports	17
Dutch bulb acreage dropped but recovered	17
Narcissus acreage remains steady . . . Wedgwood dominates the iris acreage . . . Hyacinth plantings shift towards color . . . Holland still likes tulips best . . . Gladiolus acreage shot up after the war . . . Lily acreage seems small . . . England buys the most Dutch bulbs	
THE UNITED KINGDOM	25
THE UNITED STATES LEADS IN BULBOUS IRIS, GLADIOLUS, AND LILIES	25
Most field-cut bulb flowers grow on the coasts	31
The U.S. imports from twenty-five countries	31
U.S. tariffs have come down	
America exports, even to Holland	32
Oregon leads in lilies	36
Washington	38
The field-cut flower business grows . . . Average farm size is up . . . Bulb yields vary greatly . . . Washington growers have mechanized . . . Washington began growing bulbs about 1900 . . . Early growers . . . Puget Sound area dominates . . . Puy- allup Valley Bulb Festival attracts thousands . . . Bulb growers' associations help the industry . . . Research does much for bulbs . . . Inspection fights disease and pests . . . Many varieties have been bred in the Northwest . . . The Northwest's bulb industry changes constantly	
IN APPRECIATION	57
REFERENCES	58

Introduction

The main purpose of this bulletin is to assemble the chief facts pertaining to flower bulb production in the most important producing countries, to help Washington State bulb growers chart their operations and to benefit others interested in bulb production.

The discussion deals primarily with tulips, bulbous iris and daffodils, since they are the major bulb crops of western Washington. However, data on gladiolus, lilies, and similar crops have been included whenever available. Most space is naturally devoted to the major producing countries: Canada, Japan, Netherlands, United Kingdom and United States. Not only are these countries more important—more detailed data are available for them.

Production methods vary considerably in different countries. Thus, with relatively high priced land and cheap labor, the bed system is used in Japan and the Netherlands. With cheaper land and higher priced labor, the row system with mechanization is used in the United States. In England a modified bed system is gradually yielding to the row type. Production methods and the his-

tory of bulb growing are discussed in some detail for Washington State, but more briefly for the other producing areas.

The data contained herein were obtained, of necessity, from several sources. Sometimes data for similar needs were found in more than one publication, and it was not unusual to find conflicting reports. Other data were available only as estimates by individuals. Therefore, the figures presented herein should be considered only as indicative.

The author is indebted to several individuals and governmental agencies for assistance in collecting or verifying data, obtaining photographs and for criticizing the manuscript. Credit to them is given in the last section. Although considerable effort has been made to avoid errors or omissions, it is possible that some have occurred. The writer would appreciate having these brought to his attention.

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The Flower Bulb Industry

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Bulbs do best in cool climates

Although bulb growing has been attempted at various times in most parts of the world, major production has become centered in certain temperate countries with comparatively mild climates. Generally these countries are in the north temperate zone between latitudes 30° and 55°, where the extremes of winter and summer are tempered by winds from nearby oceans or other large bodies of water.

Contrary to what many Americans think, Holland is not the native home of most "Dutch type" ornamental bulbs (tulips, narcissus and bulbous iris). Actually these bulbs came from many lands. Most originated around the Mediterranean Sea. There, the rainfall is generally heaviest during the winter months and lightest in the summer or normal curing season (Note the data for Morocco in Table 1). Hence, it is really surprising that bulbs grow so well in the Dutch climate, where the heaviest rainfall occurs in the summer and early fall. This fact probably accounts for the strong emphasis on artificial curing in Holland.

Rainfall at London, England does not vary markedly from season to season. In Japan, most precipitation occurs during the winter. The total amount is so high

that we would expect foliage diseases and leaching of fertilizers to be important problems. (In these countries, the bulb growing area may have somewhat better conditions than the above records for the nearest large city.)

Thus, available precipitation records indicate that the Pacific Northwest more closely approximates the natural curing conditions of the main bulb types than does any other major bulb growing area.

Holland is still the center of hyacinth, tulip and crocus production, while the United Kingdom grows more acres of narcissus and the United States leads in acreage of lilies, gladiolus and bulbous iris. Japan is rapidly coming back into the world bulb market with tulips after being knocked out of the lily market by the war and a better lily. Production in the United States, United Kingdom and Canada (British Columbia) is practically all devoted to domestic uses. (Table 2)

In the United States, Washington State leads in production of bulbous iris, tulips, narcissus and hyacinths; Oregon in lilies; Florida in gladiolus for cut-flowers; and Michigan in gladiolus for corms.

A rough estimate of the total worldwide ornamental bulb and corm industry is 100,000 acres with a value of perhaps \$200,000,000.

Table 1. Precipitation and temperature data for locations near major bulb growing areas (45)

Country and station	Mean Temp. °F		Average precipitation in inches												
	Jan.	July	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
British Isles: (London)	38.5	63.5	1.86	1.67	1.83	1.54	1.76	2.02	2.38	2.21	1.82	2.63	2.36	2.39	24.47
Canada: (Vancouver)	35.6	63.3	8.40	6.03	4.98	3.29	2.99	2.57	1.23	1.70	4.07	5.65	9.52	8.22	58.65
Japan: (Kanazawa)	36.8	75.6	10.79	6.82	6.17	6.74	6.07	6.69	8.18	7.07	8.78	7.48	10.45	14.40	99.64
Morocco: (Rabat)	52.9	71.0	3.48	2.38	3.59	1.48	.87	.17	.07	.01	.28	1.28	4.03	3.14	20.78
Netherlands: (Amsterdam)	37.5	63.0	2.01	1.50	1.93	1.57	1.93	2.01	2.91	3.19	2.48	3.38	2.32	2.72	27.95
United States: (Seattle)	39.5	63.1	4.87	3.49	2.79	2.04	1.69	1.37	.56	.73	1.58	2.69	4.83	5.16	31.80

Table 2. Acreage of ornamental bulb crops in major-producing areas in 1955-56

Area	Bulbous Iris	Gladiolus	Hyacinths	Lilies	Narcissus	Tulips	Miscellaneous	Total
Canada	19	79	5	6	278	86	50 ^a	523
Japan	?	238	?	529	?	550	?	?
Netherlands	578	5,960	1,464	?	2,549	8,136	2,500	21,187
United Kingdom ^b	?	?	?	?	4,428	2,659	881	7,968
U.S.—most important states								
California	75	1,000	—	122	270	10	?	?
Florida	—	11,600	—	?	50	—	?	?
Illinois	—	1,000	—	—	—	—	?	?
Michigan	—	4,000	—	—	9	12	?	?
North Carolina	200	1,500	—	?	500	20	?	?
New Jersey	—	1,500	—	—	?	?	?	?
Oregon	45	750	—	723	480	23	275	2,296
Washington	333	50	12	64	838	267	33	1,597
Total estimated U.S.	750	30-40,000	20	1,300 ^c	2,500	500	?	?

^a Rhizomatous iris, dahlias, crocus, etc.^b For 1954-55.^c Includes Creole, Georgia and garden types.

? = unknown.

— = minor.

Belgian acreage fluctuated

The total bulb acreage in Belgium has fluctuated considerably within the last ten years. In 1945 there were only 341 acres. Bulb acreage rose to 474 in 1946, 465 in 1947, dropped to 339 in 1948 and then climbed again as can be seen in the following table. Gladiolus were grown on 36 acres in 1955 and begonias (the largest bulb crop) on 437 acres. Tulips are the second most important bulb and tuber crop. Their acreage figures are given in Table 3. Iris and daffodils are not listed, but are presumably of minor importance in view of the

known acreage of miscellaneous crops (79 in 1955).

Table 3. Bulb acreage in Belgium (14)

Year	Total of all bulbs & tubers	Tulips
1948	339	23
1950	588	88
1951	504	74
1952	571	62
1953	541	54
1954	608	67
1955	619	68

Bermuda has declined

Lily production was a major industry in Bermuda before 1900. However, introduction of the virus disease, Rosette, almost extinguished this crop. Control measures were subsequently developed, but the industry never recovered its pre-

vious position in lily trade. Today exports to the United States are negligible. As Bermuda's production declined, Japan's increased and stayed at a high level until the start of World War II. (See section on Japan.)

Canada's bulb industry expanded

Most of the bulb production in Canada is confined to British Columbia. In that province the acreage increased quite steadily from 1929 to 1947. In 1947 acreage relapsed, probably owing to heavy influx of imported bulbs. In 1953, the acreage reached an all time high. Production centers in the Fraser Valley on the mainland, and near Victoria on Vancouver Island. Most of the iris, two-thirds of the tulips and one-half of the narcissus are grown on the island. Almost all of the gladiolus are raised on the mainland.

The narcissus acreage steadily increased from 1928 to 1948, when it dropped off and then began increasing again in 1952. An all time peak was reached in the

1954-1955 season. The increased acreage of narcissus apparently is due to a great extent to an increase in field-cut flower sales. Most of the other bulbs have declined recently. (Table 4)

Tulips reached their peak in 1944-45, bulbous iris and gladiolus in 1946-47, lilies and hyacinths in 1952-53. As noted above, the total acreage reached two highs, one in 1946-47 and again in 1952-53. Recently there has been an increased trend by bulb growers toward forcing their own bulbs.

Bulbs are generally planted in rows on the island and in either rows or beds on the mainland. In both instances the planting is usually done by hand. Most of the fields are small and bulb growing



Fig. 1. Field of daffodils on Vancouver Island, Canada. (Photo obtained by J. H. Crossley and used by courtesy of B.C. Government Travel Bureau.)

often represents only a part of the farming operations.

Canadian imports of all types of bulbs from all countries are now about double the prewar figures. Thus, 67,069,250 bulbs were imported in 1955-56 as compared with 35,659,721 bulbs in 1939-40. Immediately after the war (1945-46) the total was slightly over 13 million. Between 1950-51 and 1955-56, imports varied successively from 55 to 59, 65, 64, 59 and finally 67 million (26).

Most of these imports were probably tulips, if the data from British Columbia are indicative of the entire country.

British Columbia alone imports several million bulbs for retailing and forcing as well as for planting by growers. Thus, in 1954 over 3,042,415 tulips, 599,366 narcissus, 286,637 iris, 308,250 hyacinths and 792,211 bulbs of other types were imported. These data represent 321 varieties of tulips, 107 of narcissus, 14 of iris, and 36 of hyacinths (5).

Low air rates stimulated cut flowers

The sales of field-cut flowers have apparently increased rather steadily in British Columbia. Much of this increase has been stimulated by favorable air rates. In 1956 it only cost 4.3¢/lb. (in 100 lb. lots) by air vs. 6.9¢/lb. by rail to ship flowers from Vancouver to Calgary. Air delivery time was about 3 hours vs. 24 hours by rail (55).

Air shipments started in the early 1940's. By 1949 over 20 tons of field-cut blooms were being sent from Victoria. This increased to 80 tons by 1954. Air shipments from Vancouver (mostly field blooms) for the period March through May, 1954 were 54.2 tons compared with 51.4 tons in 1953 (the first available figures for the Vancouver Airport). The bulk shipments were King Alfred field-cut flowers. Since 1000 flowers weigh about 30 pounds in boxes, the 134 tons

shipped from British Columbia by air in 1954 represented almost 10 million flowers (34).

A tariff protects flower prices in Canada. The duty on flowers from the United States varies. Price samples are taken in ten United States cities adjacent to the Canadian border, during four periods: January to April, May to June, July to August, and September to December. The average prices obtained by sampling wholesalers in early morning hours are used to determine duty for the following year (35). This tariff excludes from Canada most of the field-cut flowers produced on the west coast of the U.S.

Research on bulb problems has been quite active, especially on culture. J. H.

Crossley studies culture at the Dominion Experimental Station at Saanichton. Disease work by Wm. Newton, J. E. Bosher, and R. J. Hastings has been done at the Dominion Laboratory of Plant Pathology, Saanichton. Insect research is conducted at the Dominion Laboratory of Entomology, Victoria, B. C. by H. Andison.

The growers, through their British Columbia Bulb Growers Federation, publish a newsletter containing recent findings of the research staff, new recommendations, etc. The Dominion Division of Plant Protection also publishes a newsletter containing statistics on acreage, imports, certification suggestions, etc.

Table 4. Bulb acreage in British Columbia, Canada (4)

Year	Narcissus	Tulips	Bulbous Iris	Gladiolus	Lilies	Hyacinths	Misc. ^a	Total
1928/29	66	25	5	39	—	5	19	159
1938/39	108	45	13	67	7	—	18	258
1940/41	116	83	18	67	8	3	21	316
1942/43	147	100	23	61	8	2	20	361
1944/45	178	156	36	80	14	3	16	483
1946/47	229	146	43	106	19	4	13	560
1948/49	208	101	29	66	32	4	12	452
1950/51	185	79	35	90	17	3	13	422
1952/53	263	96	28	89	40	9	45	570
1954/55	278	86	19	79	6	5	50	523

^a Most of the increase since 1951 has been in dahlias (28 acres in 1954-55), peonies (11 acres) and rhizomatous iris (8 acres).

France buys more than she sells

Detailed data on bulb crops are not available for France. The total acreage devoted to all types of flowering, medicinal and aromatic plants rose from 54,363 acres in 1950, 60,540 in 1953, to 61,776 acres in 1954. French 1953 exports of bulbs, tubers, rhizomes and asparagus crowns totaled 1,541,015 pounds as compared with imports of 6,757,099

pounds.

Exports to the United States in 1953 totaled 344,359 lbs. In 1954, the bulb exports to the United States were primarily of narcissus (1,958,070 in number), plus 229,140 hyacinths, 212,392 tulips, 204,530 lilies, 114,200 crocus corms, and 54,044 other bulbs and roots (8).

Japan reenters the world market

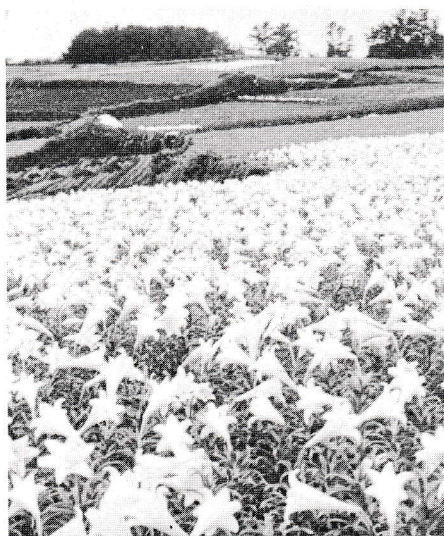


Fig. 2. *Lilium longiflorum* near Nagoya village, Japan. (Photo courtesy of Takeshi Kimura, Embassy of Japan, Washington, D.C.)

Tulips and lilies are the two most important bulb crops in Japan. Tulip growing started about 1920 and exports to the United States began in 1935. Over 5 million tulip bulbs were sent to the United States in 1955.

Japanese tulip bulbs generally had good skins, but were mostly of old varieties. However, the growers are reported to have imported stocks of new varieties from Holland during the past few years. Tulip growing is concentrated in Niigata, Toyama and certain other prefectures along the coast. The available information on tulip acreage is in Table 5.

Gladiolus production was 59,696,000 corms on 402 acres in 1953; 63,083,000 on 361 acres in 1954; 31,387,000 on 178 acres in 1955; and 45,512,000 on 238 acres in 1956 (estimated) (27).

It is reported that 13,876,000 corms were exported to all countries in 1955 (56).

A few daffodils (about 5 million—mostly King Alfred) are grown, mainly for cut-flower production. About the same number of iris are raised, mostly for forcing. Some of the latter have been exported recently to the United States at a price of about one-half that of Washington-grown bulbs, but considerable loss in them from disease was reported by forcers in the winter of 1956-57. Concerning iris, Mr. Kimura (27) has reported:

"In addition, Japanese iris (*Iris kaempferi* Sieb.) has been widely grown for use in gardens since long years ago. Many improvements have been brought about in plant breeding and some flowers reach 8 inches in diameter. Since around 1926, early forcing has been practiced by using hot-spring water in order to obtain early cut flowers. The Japanese Government recently granted a patent for the retardation of blooming by keeping the bulbs in cool storage."

Lilies were formerly the most important bulb crop in Japan; most of the exports went to the United States (Fig. 2). Mention has already been made that, as the Bermuda industry decreased, the Japanese industry increased.

Table 5. Tulip bulb acreage in Japan (27)

Year	Number of acres
1941	390 acres
1951	215 "
1952	300 "
1953	380 "
1954	462 "
1955	550 "



Fig. 3. Tulips near Tonami City, Japan. (Photo courtesy of Takeshi Kimura, Embassy of Japan, Washington, D.C.)

The acreage, production, and export data available for Japan are given in Table 6.

A Foreign Service Dispatch from the American Embassy in Tokyo (29) reports that more than 100 varieties of lilies are grown in Japan, but only three are important. These are the "Gig" (*Lilium longiflorum giganteum* Thunb.), rubrum (*L. speciosum rubrum* Thunb.) and the auratum (*L. auratum* Lindl.). The "Gig" is grown chiefly in the warm climate of Kyushu (the southernmost large island) and the latter two in the temperate climate of central Japan. The auratum is usually found wild.

Before World War II, the main export lily was the Easter lily type known as the Gig. However, the exclusion of this lily during the war stimulated a lily industry in the United States, built mainly around the Croft variety. Since the latter has several advantages over the Gig, the Japanese are encountering considerable difficulty in recapturing their former

market. This struggle is reflected in a comparison of exports for the years 1937 and 1952 (29). Most of the exported bulbs were sent to the United States in both years (Table 7).

Therefore, it is not surprising that Japanese growers have imported Croft lilies in an attempt to reestablish an Easter lily industry and recapture the market.

The Foreign Service Report (29) mentioned earlier also stated that "in their efforts to find markets after the war, Japanese growers often sold bulbs for export at prices reported to be below cost of production. To curb this practice, the Japanese Government in August, 1952 established 'check prices,' or minimum prices below which exports will not be licensed. The prices vary by variety and size of bulb."

The same report further mentioned that, "Government officials inspect the fields and supervise pest-control meas-

Table 6. Japanese production and exports of lily bulbs (27, 29)

Year	Acreage	Production no. bulbs ^a	Number exported ^b
1934	2,923	41,464,000	31,218,000
1935	2,864	46,514,000	33,294,000
1936	3,795	48,366,000	36,171,000
1937	2,859	51,583,000	40,265,000
1938	3,009	53,594,000	35,893,000
1939	2,849	53,687,000	33,855,000
1940	2,474	36,100,000	0
1941	1,568	31,908,000	0
1942	608	2,011,000	0
1943	434	643,000	0
1944	194	177,000	0
1945	56	77,000	0
1946	49	422,000	21,000
1947	105	1,302,000	496,000
1948	331	1,678,000	920,000
1949	586	4,817,000	1,845,000
1950	735	6,814,000	2,732,000
1951	688	7,001,000	3,372,000
1952	755	9,907,000	3,643,841
1953	388	9,542,000	—?
1954	706	11,461,000	—?
1955	529	18,625,000	—?

^a This production apparently includes bulbs collected in the wild. Thus, the increased production in 1955 in spite of a reduced acreage is attributed both to an increased yield per acre of cultivated plants as well as increased collection of wild lilies (27).

^b Of the 3,643,841 bulbs exported in 1952, 3,296,590 were sent to the United States; 216,996 to the Netherlands; 80,855 to Sweden; 27,960 to West Germany; 21,340 to Canada; and 100 to the United Kingdom.

ures. Beginning in 1951, the Government designated special fields for the planting of disease-free bulbs; close inspection is maintained. The Government appropriated \$16,900 for control and experimental work on lily bulbs in the fiscal year 1952."

According to J. R. McLean (32), who visited Japan in 1955, the bulb plantings are generally quite small. The average farm has from six to ten beds about 60 feet long. The president of a 900 mem-

ber cooperative had about 3 acres in bulbs. This was one of the largest plantings.

Japanese philosophy is that food comes first, flowers for home consumption next, and finally bulbs for export, if any are left over. The labor is mostly family labor, so the cost of production is low. McLean stated that there are large acreages of favorable soil types, but at the present time they are mostly devoted to food production.

Table 7. Exports of different types of lilies from Japan, 1937 and 1952 (29)

Year	Total number	Percentage of types			
		Gig	Rubrum	Auratum	Others
1937	40,265,000	78	15	6	1
1952	3,643,841	25	50	15	10

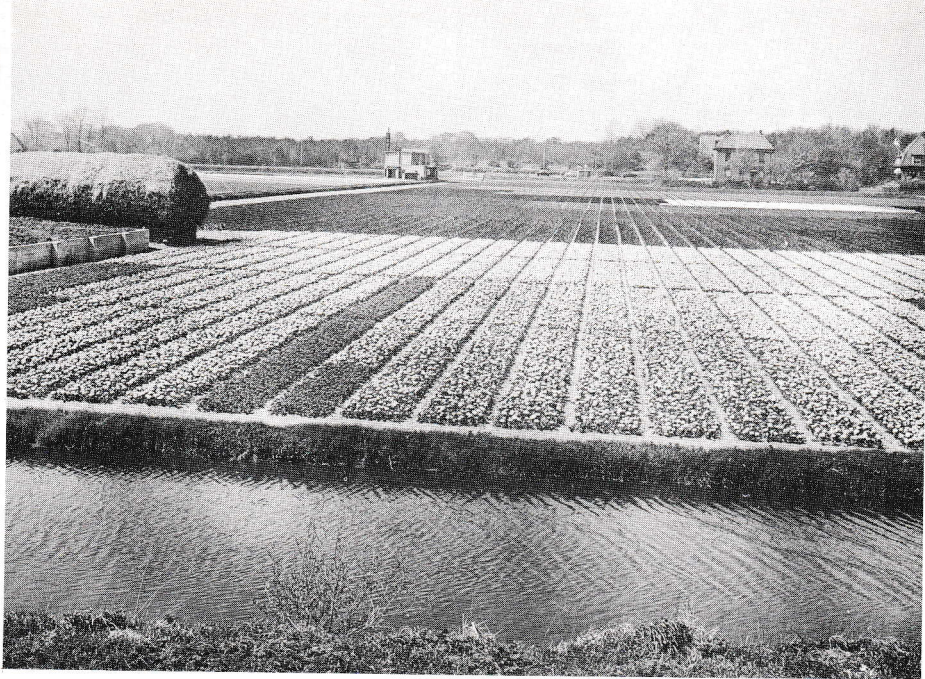


Fig. 4. Bulb field in the Netherlands. The stack of reeds in the left foreground is used for mulching. (Photo courtesy of Dr. A. S. Tuinman, Netherlands Embassy, Washington, D.C.)

Most Dutch farms are small

Bulbs have been grown in Holland for almost 400 years. Soon after a few tulip bulbs were introduced into the country in 1559, interest and speculation soared. The madness reached a peak about 1630 in the so-called "tulip mania." Fortunes were exchanged for single bulbs.

After the inevitable collapse, the industry slowly recovered, reaching a high of 25,498 acres of all bulbs in 1932. After that the world wide depression created such chaos that a reduction was ordered in plantings of hyacinths, tulips, and narcissus to 13,800 acres. At the same time some controls against expansion were applied. These have evolved into a system described later.

The average bulb planting is quite small (Fig. 5). For instance, in 1950-51 7,334 farmers grew 0.1 to 2.5 acres of bulbs each; 694 grew between 2.5

and 25; and only 29 growers had over 25 acres. The average was about 1.2 acres (12-9/14/51). However, it should be remembered that the Dutch use the bed system. Thus they get at least twice as many bulbs per acre as with the row system used in the United States and elsewhere.

The industry, which first centered around Haarlem, has spread to two main areas: the southern area or "Bloembollenstreek" between Haarlem and Saassenheim and the northern area north of Haarlem, particularly around Breezand and Anna Paulowna. Most hyacinths are grown in the South, most iris, gladiolus and minor bulbs in the North; and tulips and daffodils in both.

Much of the land used for bulb production has been reclaimed from the sea or lakes (called polders), or from dunes.

Although some new land is still being obtained in this way, the potential amount is quite limited.

The soil varies from a coarse sand in the south to a fine sandy loam in the north, with areas of peat and clay in both districts.

Bulbs are generally planted in beds about 3 x 37 feet with 15 inch paths in between (Fig. 6). Soil is removed from one bed, which is then planted. The bulbs are then covered with top soil from the next bed. This process is repeated across the field. The last bed is covered with soil from the first. The beds are marked before planting so that the bulbs are located and spaced uniformly. This spacing facilitates roguing and digging.

Because there is considerable danger from freezing in Holland, reed or straw mulches are widely used. The thickness varies with the crop. As much as 6 inches may be used for hyacinths. These mulches, plus hedges, also help to reduce injury from wind-blown sand. In addition, during spring and summer, cereal and other plants are grown in the paths, or straw is stuck upright in the paths to lessen erosion.

As would be expected in view of the light soil and heavy rainfall, considerable leaching of nutrients occurs. Therefore, both cow manure and chemical fertilizers are very heavily used. Growers work super-phosphate into the soil before planting. Other nutrients such as am-



Fig. 5. Tulip field in the Netherlands showing hedges. (Photo courtesy of Professor Dr. E. Van Slogteren, Laboratory for Flower Bulb Research, Lisse.)



Fig. 6. The Dutch usually plant bulbs in beds 3 feet wide and 37 feet long. A 15-inch path is left between beds. (Photo courtesy of Dr. A. S. Tuinman, Netherlands Embassy, Washington, D.C.)

monium sulfate are applied on top in late winter or early spring.

Growers manipulate the water level in adjacent canals to keep the water table about 2 feet below the surface. However, in the northern area, this is not always possible and some overhead irrigation is required. The canals also serve as a means of drainage and transportation (Fig. 4).

Netherlanders weed, rogue and do much spraying by hand. Some spraying is partially mechanized by the use of booms carried by hand but connected by hose with pumps in boats on adjacent

canals. The latest trend is toward mist spraying with machines capable of blowing a fungicidal mist a considerable distance.

Prior to digging, the leaves are cut off, while still green. Bulbs are dug by hand (Fig. 7). During the summer the weather is usually unfavorable for proper curing so most types of bulbs are cured artificially. Daffodils are often cured outdoors in covered stacks. Bulbs are usually cleaned by hand and graded by machine.

Because hyacinths and other bulbs grown in Holland may not mature in time for early forcing in countries such



Fig. 7. Digging bulbs is a hand job in the Netherlands. (Photo courtesy of Dr. A. S. Tuinman, Netherlands Embassy, Washington, D.C.)

as Sweden, the Dutch developed a unique method of hastening the maturing process several years ago. Growers bury steam pipes or electric heating cables below the level of the bulb planting. They turn on heat in the spring and accelerate the maturing of the bulbs for earlier digging. Several acres of bulbs are treated in this way, but heat, of course, is expensive. Hyacinths are the main crop grown in such fields, but other bulbs are sometimes matured in similar fashion.

Since good land is in short supply, a vertical rotation is often practiced at regular intervals. The soil is inverted by hand, so that the upper layer is placed near water level and the bottom layer is brought up to the surface. This method, if carefully performed, supposedly destroys both pests and weed seeds. This practice is somewhat comparable with deep plowing in the United States.

More drastic steps are now being adopted on the oldest land. Special pump-

ing machines bring up fresh lime-rich sand layers from 10 to 30 feet below the surface, while the latter is being inverted. Needless to say the cost is quite high. The procedure also requires considerable care to prevent mixing of unfavorable soil types.

The Dutch follow several crop rotation systems. One popular one is a sequence of tulips, hyacinths, and narcissus, followed by iris or gladiolus or by an inversion of the soil.

Efforts at mechanization are being made in an attempt to reduce costs, but a number of difficulties are present. Land is very expensive, which precludes leaving much unplanted land for turning spaces. The sandy soil and high water table also result in the soil's being too soft to support heavy equipment. Finally, much of the land is cut up into small areas by canals and hedges and this prohibits efficient use of mechanized equipment. However, northern growers

are trying small machines and row planting on less expensive land in larger fields.

Per acre yields of bulbs, as mentioned previously, are larger by their bed system than by our row method. Thus the average production of salable King Alfred narcissus bulbs over a recent four-year period in Holland was 39,830 DN1 and 25,605 DN2 per acre, for a total of 65,435 DN (double nose) 1 and 2 bulbs. This production compares with an estimated 17,500 DN1 and 2 per acre for Washington State.

The total average cost of production in Holland per salable bulb (all sizes) in 1954-55 was 1.2¢ (U.S.) for tulips, 1.7¢ for King Alfred, and 3.1¢ for hyacinths. This represented an increase in cost of about 8% over 1953-54 (12-6/3/55).

Auctions are unique

Dutch bulbs are sold either direct to exporters or by a unique system at auctions. Auction prices start high and steadily drop until a sale is made. An electric dial with a hand that rotates from high to low indicates prices on the perimeter of the dial. A buyer makes a purchase by pressing an electric button at his seat. The hand automatically stops at the price indicated and the seat number lights up in the center of the dial. The buyer states the number of bulbs desired, and the process starts over. The procedure is very rapid.

Growers also may buy or sell bulbs at the Krelage Bulb Exchange in Haarlem. This is an informal gathering, on Mondays, with the business conducted individually. New varieties are also shown and sold here and the speculation on them is as active as our own Stock Exchange. Some bulbs may also be auctioned off in the fields during the growing season (1).

Prices are stabilized by establishing

minimum inland and export prices; by limitation of acreage planted; and by purchases of surplus bulbs. The inland minimum prices are fixed at approximately the cost of production. The minimum export prices are now based partly on the approximate buying prices during the fall prior to harvest.

Growers cannot increase their acreage of tulips, narcissus and hyacinths in excess of their permits, unless a general increase is decreed, or they are freed from restrictions. For example, hyacinths were freed from 1948-49 to 1952-53. Since decreases can also be ordered, the method provides a rough means of balancing supply with demand. A fixed percentage set aside usually provides for new and young growers.

Breeding new varieties is one of the main delights of Dutch bulb growers. Bulb breeding has been continuous for hundreds of years. More than 12,000 varieties of daffodils and hyacinths, plus other thousands of varieties of tulips and gladiolus have resulted.

Promising new varieties are eagerly sought. However, some of the older varieties are still popular. Examples are the King Alfred narcissus (bred in 1889); hyacinths L'Innocence (introduced in 1863); Pink Pearl (1903); Bismarck (1875); and tulip Keizerkroom (1750 or earlier) (13). A register of new tulip and hyacinth varieties is kept at the Krelage House at Haarlem, while the Royal Horticultural Society in England maintains the narcissus register.

Bulbs that cannot be sold are bought by the Surplus Fund at the fixed minimum prices with funds paid by growers in proportion to the sizes of their crops. Surpluses are estimated before harvest and assessments are made accordingly on each sale. Adjustments and refunds are made later, if necessary.

The surplus purchases naturally vary from year to year. Thus, they fluctuated from 8 to 17.4 to 9.6 per cent in the years 1946-47, 1947-48, and 1948-49. In the latter year with a total production of 658 million bulbs, the surpluses amounted to about 3.4 million narcissus and 58.6 million tulips (41). However, in 1954 the surplus only amounted to 305,000 tulips (of 782 million total); 1,270,000 narcissus (162 million total); and 3,255,000 hyacinths (88 million total) (42).

The above operations of surplus purchases, acreage limitation and price setting are made by the P.V.S. (Product-schap voor Siergewassen, or Ornamental Horticulture Marketing Board). The Board is composed of a total of twenty-four members, eight each from bulb, flower and tree groups; with exporters, growers, inland traders and employees all represented. The government appoints a chairman on recommendation of the industry. The Board enacts and enforces regulations under the supervision of the Ministry of Agriculture (15).

Bulb flowers are exhibited in several shows, parks, etc. One of these is very outstanding and has become a tourist mecca. It is the "Keukenhof"—an old estate near Lisse. In 1953 10 million bulbs were planted along 15 miles of walks on 75 acres and visited by more than 300,000 people. The Treslong demonstration garden in Hillegom grows new varieties for display and a collection of old varieties is maintained at the Hortus Bulborum at Limmen.

Most of the inspection is done by the "P.D." (Plantenziektenkundige Dienst), a government unit. Formerly, inspectors working for the bulb growers' association made field inspections, but the P.D. took over this work in 1954.

New growers may not start without a diploma. This diploma is obtained by

attending a bulb school at Lisse for three winters and working on bulb farms under supervision of the teachers in the summer. In addition to the school, there are also some elementary horticultural schools and evening classes for both new and old growers. The teachers also act as advisors to growers (under the Government Information Service) and carry on some "applied" research and demonstrations at the school and in growers' fields. These schools and advisory services are under the direction of Dr. A. F. Flag.

In addition to technical publications from the scientific institutions, three weekly newsletters help keep the growers up to date on latest recommendations, prices, etc. They are the *De Hobabo*, published by the N. V. Holland's Bloembollenhuis (auction house at Lisse), *Het Vakblad* from the Coop. Bloem. H.B.G. at Hillegom, and the official organ of the bulb association, the *Weekblad voor Bloembollencultuur*, published by the Koninklijke Algemeene Vereniging voor Bloembollencultuur at Haarlem. There are also paid consulting service publications.

Many Dutch problems resemble ours

Dutch bulb problems, in general, are similar to those in the United States. Fungus and virus diseases are just as troublesome. These are being investigated primarily by Prof. Dr. E. Van Slogteren's group at the Laboratory for Flower Bulb Research at Lisse. This group has made much progress in developing serological tests for the identification of some viruses in plants. Such tests have enabled the Dutch to clean up certain virus-infected stocks of some types of bulbs, as well as those of potatoes and certain other plants.

A virus disease of tulips still under investigation at the Laboratorium is commonly called the Augusta disease. It is caused by the tobacco necrosis virus, which has been found in the roots of about eighty host plants. The culture of tobacco and potatoes helps increase the disease.

Tulips apparently are infected as the sprouts push through the soil. The virus moves downward in the plant, produces dead spots and streaks, and stunts, distorts, or kills small plants. The virus apparently can be carried in both infested soils and in bulbs.

This disease does not seem widespread in Holland and efforts are being made to eradicate it. Augusta disease is not yet established in the United States.

Sending bulbs to the southern hemisphere is quite a problem to the Dutch growers. Countries of the southern hemisphere purchased \$361,000 worth of bulbs in 1950. Thus the problem cannot be ignored. Because of the reversal in seasons, the bulbs would ordinarily arrive there at the hottest time of the year. Some excellent research by Dr. Beyer at the Lisse Laboratory has provided at least a partial solution. The bulbs are retarded by various means.

Hyacinths and daffodils are stored from digging until October 15 at 86° F.; next at 31° F. until January 1; and then 78° F. until shipped.

Iris are stored continuously at 78° F.

Tulips (particularly bulbs that did not flower in the preceding year, commonly called pears or maidens) are placed at 31° F. until January, when they are transferred to 78° F. until shipped (43).

Research on bulb curing and forcing is being carried on at Lisse and at the Laboratory of Plant Physiological Research of the Agricultural University at Wageningen. The Experimental Station of Floriculture at Aalsmeer is working

on forcing under artificial light. Building construction is being studied by the Institute of Horticultural Engineering at Wageningen.

Holland's growers unite

Bulb growers banded together in 1860 to form the Koninklijke Algemene Vereniging voor Bloembollen Cultuur (Association of Bulb Growers) and later (1925) the Centraal Bloembollen Comité (C.B.C.) or Central Flower Bulb Committee. The latter organization apparently dominates bulb affairs, both domestic and foreign (1). The committee is now composed of representatives of the different bulb societies (iris, tulips, etc.) and exporting associations. Funds for its operations are raised by assessments on the bulbs.

In 1955 the committee's budget was about \$766,000, which was used largely for research (\$110,963) and advertising (\$647,221). Most of the research money is used to support the Laboratory for Flower Bulb Research at Lisse, which receives very little financial support from the government. In 1926 the C.B.C. contributed 2½ times as much to research as it spent on advertising. However, by 1955 the advertising budget was almost six times as large as the research budget (12-8/3/56).

The amount spent on advertising began to increase rapidly after the war. In 1949, the C.B.C. spent \$171,475 for advertising in the United States. The amount rose to about \$340,790 in 1954, but dropped to \$232,945 in 1955. Sizeable amounts were also spent in Canada (\$38,769), England (\$77,908), France (\$55,736), Sweden (\$63,319), and Germany (\$79,249).

In general the advertising was increased over that of 1954 in Europe (particularly Germany) and decreased in England, Canada and the United States.

In the U.S., the main decrease (\$92,000) was for printed matter. Detailed amounts spent in the United States in 1955 are listed in Table 8.

Table 8. General advertising in the U.S. by the Dutch Central Flower Bulb Committee in 1955 (12-8/3/56)

Advertising in papers and magazines	\$ 46,636
Dealer aid	51,611
Printed matter	19,653
Public relations	85,527
General costs	29,518
Total	\$232,945

Recently the trade paper, *De Hobaho*, gave the following figures and information on bulb exports from Holland to the United States (12-8/26/55 and 10/14/55). There is some discrepancy between these figures and those available from the United States Department of Commerce. However, the trends are similar in both cases. (Table 9)

Writers in *De Hobaho* commented that "These figures are a reflection of the grim struggle which has to be fought for bulbs in the United States. Fighting has to be done on many fronts, which we would like to classify as follows:

1. To increase the demand of the general public;

2. To increase the knowledge of the treatment of bulbs;
3. To educate the florists and dry-salers;
4. To fight against gladioli and chrysanthemums."

These points are being "fought for" by various methods, including:

1. The movie called "A Gift from Dirk"
2. Colored posters in seed stores
3. Folders containing planting directions (and also showing in color, the flowering times of different bulbs)
4. The education of florists with detailed cultural directions
5. Requesting florists to enclose a picture of a pot of red tulips in their statements to customers
6. Use of radio and television
7. Advertising in such trade magazines as *American Nurserymen*, *Florist's Review*, etc.
8. Ads in forty-one newspapers
9. Supplying advertising mats and information to dealers (mailing list: 14,500)
10. Stimulating the publishing of articles on bulbs in magazines. This program is especially active.

Dutch representatives even made a trial test in Boston to stimulate, through advertising, the use of forced bulbs, but concluded that it was not financially feasible for the entire country. Instead

Table 9. Number of bulbs exported from Holland to the U.S. in recent years (12-8/26/55)

Variety	1950	1951	1952	1953	1954
Tulips	130,000,000	135,500,000	158,000,000	168,000,000	167,000,000
Hyacinths	23,300,000	22,900,000	24,200,000	25,900,000	27,500,000
Daffodils	21,700,000	20,100,000	23,800,000	26,600,000	26,400,000
Gladioli	120,000,000	124,000,000	135,000,000	178,000,000	134,000,000
Iris	59,000,000	48,000,000	72,000,000	50,000,000	28,000,000
Total	354,000,000	350,500,000	413,000,000	448,500,000	382,900,000

the Dutch are trying to reach the same objective by supplying articles to newspapers (directly or through syndicates and authors) on methods of obtaining the best results with forced bulbs.

Although we may question some of their methods and certain comments about superior quality, we can't quarrel with one of their statements—"A great number of Americans who have a garden have to be taught yet how to become a garden lover" (12-8/26/55).

Another important bulb group is the Dutch Bulb Exporters Association, organized in 1900. In 1950 it represented 279 firms for cooperative action on tariffs, quarantines, etc. (18).

Trade barriers affect flower exports

Holland formerly exported both bulbs and bulb flowers. However, beginning in 1881, England and Germany objected to the flower imports and in 1914 Holland agreed to refrain from sending cut bulb flowers to those countries (1).

According to Van Ginhoven (51) cut tulip flowers began coming into the United States from Holland in increasing quantities shortly before World War II. Soon after the war ended, negotiations started by the National Affairs Committee of the Society of American Florists resulted in the establishment in Holland of a minimum export price for cut tulip flowers.

Late in 1950, the committee succeeded, with the cooperation of the Dutch Bulb Exporters Association, in having Holland institute a new regulation. Under the new rule export licenses would be issued only on orders accompanied by cash. This requirement has practically excluded cut tulips from the United States. Only 772 dozen cut tulips were imported in 1955 and these were for exhibition.

Separate data for field-cut flowers in Holland are not available. However, the

combined figures for both greenhouse and field production are interesting.

Table 10. Cut flowers sold in Holland in 1950 (36)

Crop	Number	Av. price (in U.S. cents)
Tulip	81,798,410	1¢
Narcissus	34,517,115	1½¢
Gladiolus	16,459,365	1½¢

(In 1950, almost 55 million roses and over 56 million carnations were sold for approximately 2½ cents apiece.)

A report recently stated that flowers are now being shipped by air from the Mediterranean area to northern and central Europe. This innovation may have as much impact on Holland forcers as the Florida field-grown gladiolus and chrysanthemums have had on forcers in the northern United States.

Dutch acreage dropped but recovered

The total bulb acreage passed the 20,000 acre mark in 1954-55 for the first time in many years. The present acreage (21,187) is almost double that of 1917-18 (11,977), but not as large as in 1932-33 (25,498). The acreage of most of the bulb types is now (1955-56) about the same as that planted just before the war (1938-39), with the exception of gladiolus acreage which has doubled.

The general trends in acreage of different bulb crops in Holland are summarized in Table 11. The data were obtained from two sources: the P.V.S. (Produktschap voor Sierteeltprodukten), which gets its data on tulips, hyacinths and narcissus by measurements in connection with acreage control and data of other bulbs from estimates from bulb associations; and the C.B.S. (Central Bur-

Table 11. Trend in acreage of ornamental bulb crops in Holland^a (44)

Crop	1938-39	1950-51	1951-52	1952-53	1953-54	1954-55	1955-56
Bulbous Iris	897	895	979	744	606	483	578
Gladiolus	2,760	5,283	4,557	3,901	5,170	5,881	5,960
Hyacinths	1,255	1,096	1,207	1,418	1,350	1,456	1,464
Narcissus	2,318	2,395	2,559	2,644	2,676	2,562	2,549
Tulips	8,673	6,021	6,582	6,807	6,806	7,466	8,136
Miscellaneous	1,984	2,135	1,604	1,695	2,053	2,350	2,500
Total	17,887	17,825	17,488	17,209	18,661	20,198	21,187

^a Data supplied by the P.V.S. and/or the C.B.S. The C.B.S. was the source for all crops in 1938-39, and for gladiolus and miscellaneous every year.

eau of Statistics), whose data are obtained from growers. Cut flower production data are not included in either P.V.S. or C.B.S. figures.

Because the P.V.S. does not collect data for gladiolus and miscellaneous crops, nor did they collect them for any crop in 1938-39, the C.B.S. figures are used in these cases. Detailed data on varieties in Tables 11-15 are from the P.V.S. In addition to the sources of data listed in this article, there is an excellent account (in the Dutch language) of Holland's bulb growing and export industry in: "Drie Eeuwen Bloembollen Export," by E. H. Krelage, The Hague, 1946 (28).

Narcissus acreage remains steady

The narcissus acreage in Holland has remained over the 2500 acre mark since 1952. It climbed to 2676 in 1953-54, but dipped slightly in the next two years. The leading variety, King Alfred, accounts for about one-seventh of the total. It, together with Golden Harvest, Carlton, and Rembrandt, makes up almost half of the entire acreage. Varieties (25 acres or more) that have at least doubled since 1951 are Magnet, Mount Hood, Rembrandt, Unsurpassable and Verger. (Table 12)

Wedgwood dominates the iris

The two leading varieties of iris in

Holland are still Wedgwood and Imperator, but their acreage has decreased considerably since the peak year of 1951-52 owing, in part at least, to a severe freeze in 1953. Golden Harvest, H. C. Van Vliet, and White Excelsior are the other leading varieties, with Prof. Blaauw (Blue Ribbon) increasing rapidly. White Perfection increased rapidly up to 1953, but the acreage has leveled off since then.

The total acreage of miscellaneous Dutch types of iris is also increasing, which probably indicates that some promising varieties are coming along. Because of the increasing interest in some of the newer varieties, data for all years since 1948-49 are included in Table 13.

Hyacinth plantings shift toward color

The hyacinth acreage increased from 1950-51 to 1955-56, with a minor drop in 1953-54. The trend has been towards red, blue and yellow and slightly away from white. The reds and blues now make up about two-thirds of the acreage, followed by white and yellow. Double varieties are quite minor. (Table 14)

The three leading varieties (Pink Pearl, L'Innocence, and Bismarck, in that order) make up about forty per cent of the total. Varieties of five acres or more that at least doubled in acreage between

Table 12. Acreage of narcissus varieties grown on 25 acres or more in Holland, 1950-56^a

Variety	50-51	51-52	52-53	53-54	54-55	55-56
Actea	98	98	90	80	63	61
Carlton (Nimrod)	159	186	217	239	240	246
Cheerfulness	77	72	70	57	47	42
Flower Record	27	43	54	52	48	49
Fortune	72	80	102	115	96	74
Geranium	58	64	76	84	92	79
Golden Harvest	152	173	191	234	247	268
Helios	88	73	63	50	35	25
King Alfred	446	454	444	451	418	389
Magnet	11	15	20	24	27	26
Magnificence	48	41	38	45	44	35
Mount Hood	0	8	14	20	27	36
Rembrandt	123	167	200	217	218	228
Scarlet Elegance	74	82	67	43	34	33
Texas	22	24	24	27	35	43
Unsurpassable	16	22	30	39	50	59
Van Sion	80	75	65	63	61	72
Verger	23	31	41	43	45	52
Total above varieties	1,574	1,708	1,806	1,883	1,827	1,817
Grand Total	2,395	2,559	2,644	2,676	2,562	2,549

^a Data are rounded to nearest whole numbers. (Sources: 52 and 12-7/18/52; 2/6/53; 2/5/54; 2/11/55; and 2/10/56).

1950-51 and 1955-56 are: Crownprincess Margaretha, Carnegie, Delight, Delft's Blaauw, Myosotis, Ostara, Princess Irene, and Lord Balfour. The most rapid increase has been in Carnegie, Delft's Blaauw (Blue) and Delight. The acreage figures for varieties of 25 acres or more follow:

Holland still likes tulips best

Tulips were the first and are still the main love of the Dutch as evidenced by the size of the crop and the intense breeding of new varieties. The tulip acreage rather steadily increased from 1950-51 to 1955-56, reaching a total of 8,136 acres in the latter year. This amount is believed to surpass the tulip acreage for all the rest of the world combined. (Table 15)

Darwin tulips represent only one-fourth of the total now, as compared with one-third in 1950-51. The double late, triumph and botanical types have increased very rapidly since 1950-51.

Varieties grown on more than 200 acres are: Brilliant Star, Golden Harvest, Krelage's Triumph, Rose Copland, and Ven der Eerden. Varieties of 25 acres or more that have at least doubled their acreage since 1950-51 are: Aristocrat, Bellona, Cordell Hull, Demeter, Edith Eddy, Elmus, Fuga, Lustige Witwe, Madame Lefeber, Olaf, Paris, Paul Richter, Pax, Piquante, Preludium, Princess Beatrix, Princess Margaret Rose, Red Champion, Red Giant, Roland, Topscore, Wintergold, Wm. Copland's Purple, and Wm. Copland's Rival.

Table 13. Bulbous iris acreage in Holland^a

Variety	48-49	49-50	50-51	51-52	52-53	53-54	54-55	55-56
Blue Triumphator	7	6	8	10	10	8	3	3
Golden Emperor	7	12	19	19	14	11	11	13
Golden Harvest	25	38	52	56	42	35	30	39
H. C. Van Vliet	25	34	56	61	50	46	48	59
Imperator	116	128	148	157	100	81	74	84
Jeanne d' Arc	—	1	3	5	7	7	4	4
Lemon Queen	—	—	—	2	4	3	3	4
Prof. Blaauw (Blue Ribbon)	—	—	2	5	8	13	12	18
Saxe Blue	—	4	5	4	3	2	3	4
Wedgwood	198	302	426	478	351	263	179	224
White Excelsior	44	54	73	90	74	52	40	39
White Perfection	—	2	4	8	14	16	16	16
White Superior	6	8	10	13	17	16	13	11
Yellow Queen	32	48	55	37	16	14	9	11
Misc. Holland Iris	24	22	22	25	28	33	32	42
Misc. Spanish Iris	7	10	12	9	6	6	6	7
Total	491	669	895	979	744	606	483	578

^a Data are rounded to nearest whole number. (Sources: 52 and 12-2/4/55 & 2/10/56)

Table 14. Acreage of hyacinth varieties grown on 25 acres or more in Holland^a

Variety	50-51	51-52	52-53	53-54	54-55	55-56
Anne Marie	16	17	20	19	24	32
Bismarck	116	128	151	132	137	131
Carnegie	5	7	10	17	23	33
City of Haarlem	34	40	52	54	55	50
Delft's Blauw	8	14	25	32	46	56
Jan Bos	32	40	49	53	60	64
King of the Blues	23	27	32	30	33	35
La Victoire	34	40	50	52	52	52
Lady Derby	28	32	38	39	46	46
L'Innocence	234	241	248	198	199	166
Marconi	29	30	36	41	46	49
Ostara	30	38	56	61	65	66
Pink Pearl	176	188	218	225	255	270
Queen of the Pinks	34	37	40	36	39	41
Total above varieties	799	879	1,025	989	1,080	1,091
Grand Total	1,096	1,207	1,418	1,350	1,456	1,464

^a Data are rounded to nearest whole numbers. Sources: (52 and 12-3/26/54 and 2/10/56)

Table 15. Acreage of tulip varieties grown on 25 acres or more in Holland, 1950-56^a

Variety	50-51	51-52	52-53	53-54	54-55	55-56
<i>Single Early Tulips</i>						
Bellona	2	3	8	14	24	37
Brilliant Star	160	176	208	234	276	306
Couleur Cardinal	76	81	88	90	100	118
Crown Imperial	54	62	54	38	33	28
General de Wet	60	56	49	44	41	38
Ibis	86	84	78	62	56	56
Keizerkroon	50	48	50	58	62	67
Prince of Austria	48	46	43	38	35	33
Total above varieties	536	556	578	578	627	683
Total Earlies	914	936	928	898	926	973
<i>Double Early Tulips</i>						
Electra	62	74	88	98	101	93
Marechal Niel	40	42	44	48	46	46
Mr. van der Hoef	98	114	123	102	88	80
Orange Nassau	90	100	110	129	136	128
Peach Blossom	114	119	130	130	130	124
Triumphator	21	24	28	32	32	29
White Murillo	21	28	32	30	27	26
Total above D.E. varieties	446	501	555	569	560	526
Total Double Earlies	629	703	778	794	790	759
<i>Single Late Tulips</i>						
Golden Harvest	161	162	198	203	232	278
Mrs. John T. Scheepers	28	30	34	32	30	30
Princess Margaret						
Rose	28	48	52	48	62	77
Total above S.L. varieties	217	240	284	283	324	385
Total Single Lates	571	628	654	634	710	804
<i>Double Late Tulips</i>						
Total	58	77	114	146	173	174
<i>Botanical Tulips</i>						
Madame Lefeber	42	48	56	80	110	132
Total, all Botanicals	76	84	97	140	197	239

(Cont.)

Table 15 (Cont.)

Variety	50-51	51-52	52-53	53-54	54-55	55-56
<i>Breeder Tulips</i>						
Dillenburg	33	36	32	24	23	26
Total Breeders	98	102	96	79	79	78
<i>Darwin Tulips</i>						
All Bright	58	62	59	56	59	59
Aristocrat	19	21	28	36	40	41
Bartigon	174	193	150	116	103	105
Campfire	82	85	78	70	71	76
Clara Butt	40	46	44	40	42	42
Demeter	11	14	18	23	26	27
Paul Richter	2	4	7	14	28	45
Philip Snowden	64	70	62	56	52	51
Pride of Haarlem	40	44	33	32	32	33
Princess Elizabeth	84	86	78	65	62	57
Prunus	58	66	67	66	66	70
Queen of Night	36	42	44	42	48	59
Red Pitt	52	52	52	50	53	61
Rose Copland	334	365	360	347	356	387
William Copland	77	70	59	37	31	30
William Copland's Purple	13	20	16	19	26	36
William Copland's Rival	22	24	25	32	35	45
William Pitt	170	160	132	82	74	73
Zwanenburg	40	42	34	26	26	26
Total above Darwins	1,376	1,466	1,346	1,209	1,230	1,323
Total Darwins	1,952	2,080	1,960	1,800	1,872	1,979
<i>Mendel Tulips</i>						
Early Queen	40	40	42	40	36	33
Fridjof Jansen	32	33	34	32	32	33
Fuga	10	13	15	16	21	25
Her Grace	27	34	44	48	50	44
Krelage's Triumph	219	244	236	195	209	227
Olaf	4	6	9	16	26	35
Orange Wonder	14	14	21	26	26	25
Piquante	14	14	18	22	25	29
Topscore	3	7	11	15	24	33
Van der Eerden	128	140	162	174	205	241
White Sail	100	121	91	60	60	160
Total above Mendels	591	666	683	644	714	885
Total Mendels	822	926	963	912	1,006	1,089

(Cont.)

Table 15 (Cont.)

Variety	50-51	51-52	52-53	53-54	54-55	55-56
<i>Parrot Tulips</i>						
Blue Parrot	51	49	52	52	62	72
Fantasy	74	72	62	54	57	60
Orange Favourite	34	46	42	34	39	43
Red Champion	43	60	74	84	95	103
Sunshine	24	30	25	23	25	25
Total above Parrots	226	257	255	247	278	303
Total Parrots	302	345	358	363	410	454
<i>Rembrandt Tulips</i>						
Cordell Hull	33	42	50	58	66	72
Total Rembrandts	41	54	67	78	89	99
<i>Triumph Tulips</i>						
Crater	33	33	34	35	39	39
Denbola	27	28	34	42	46	48
Edith Eddy	76	90	106	130	154	185
Elmus	46	59	82	97	116	135
Korneforos	78	75	84	98	114	125
Merry Widow	3	4	9	14	24	38
Paris	1	4	10	21	40	57
Pax	4	8	18	30	38	46
Preludium	1	3	6	12	21	31
Princess Beatrix	10	12	17	24	32	34
Red Giant	12	18	25	36	53	67
Rijnland	21	24	26	26	29	32
Roland	4	6	12	22	38	47
Wintergold	5	10	16	24	34	44
Total above Triumphs	321	374	479	611	778	928
Total Triumphs	554	641	787	966	1,210	1,442
<i>Miscellaneous</i>						
Total	2	4	3	2	3	4
Early Tulips	1,544	1,640	1,706	1,693	1,716	1,732
Late Tulips	4,477	4,942	5,101	5,113	5,750	6,404
Grand Total	6,021	6,582	6,807	6,806	7,466	8,136

* Data are rounded to nearest whole number. Source: (52, 12—4/6/54, 3/16/56, 3/23/56, 3/30/56)

Gladiolus acreage shot up after the war

Gladiolus production increased rapidly in post-war years, dropped in the early

1950's and since then has climbed to a post-war peak of 5,611 acres. The most popular variety is Snow Princess, but fourteen other varieties occupy over 100 acres each.

Several varieties are increasing rapidly in acreage. Those of 25 acres or more in size that have at least doubled in the last three years are: American Express, Flower Dream, Lustige White, Mabel

Violet, Maria Goretti, Morning Kiss, Pactolus, Phillip Memory, Sans Souci, Spic & Span, Sunny Boy, and White Autumn. Data on varieties grown on 50 acres or more are listed in Table 16.

Table 16. Acreage of gladiolus varieties grown on 50 acres or more in Holland^a

Varieties	1954	1955	1956
Acca Laurentia	87	122	146
Alfred Nobel	66	68	94
Allard Pierson	84	66	71
Bloemfontein	92	126	135
Dr. Fleming	77	88	107
Gen. Eisenhower	99	126	91
Hawaii	72	153	164
Hopmans Glory	94	71	58
Joh. Strauss	152	214	244
Jo. Wagenaar	50	70	72
Kard. Spellman	57	64	70
Leuvenhorst	143	225	270
Mabel Violet	7	26	59
Mansoor	137	132	122
Maria Goretti	16	49	60
Memorial Day	112	121	120
Modern Times	157	202	136
Morning Kiss	83	109	167
Mrs. Marks Memory	60	59	52
Nieuw Europa	386	325	241
Pactolus	25	48	82
Palet	66	71	52
Philip Memory	—	—	97
Picardy	357	210	139
Rosa V. Lima	—	67	50
Sans Souci	—	43	147
Silhouet	39	76	75
Snow Princess	394	588	409
Spic and Span	—	38	104
Spotlight	107	102	60
White Autumn	—	30	74
Total above varieties	3,019	3,689	3,768
Grand Total	4,934	5,410	5,611

^a Data rounded to nearest whole numbers. Sources: (12—8/5/55 and 8/10/56)

Table 17. Weights and value of bulb exports from Holland to major countries, 1950-55*

To	Exports in Pounds						Value
	1950	1951	1952	1953	1954	1955	1955
Canada	3,293,899	3,514,324	4,180,064	4,451,190	4,313,568	4,216,617	\$ 1,357,243
United States	23,155,160	22,852,332	29,552,439	31,373,672	27,572,285	26,950,156	10,737,236
Belgium and Luxemburg	2,323,008	2,720,733	3,169,540	3,516,757	3,302,226	3,216,772	1,075,519
West Germany	14,047,414	9,925,188	13,504,018	14,561,736	19,615,428	24,503,703	7,785,626
England	27,714,574	42,004,362	29,424,390	32,109,024	31,710,208	31,554,967	8,938,747
France	5,586,088	7,038,422	5,470,264	6,170,604	8,071,096	9,083,842	4,200,648
Sweden	10,140,482	10,508,513	11,540,524	11,789,896	12,242,588	12,612,466	5,740,434
Total above countries	86,260,625	98,563,874	96,841,239	103,964,779	106,827,399	112,138,523	\$39,835,453
Total all countries	96,026,942	109,756,220	110,144,566	118,465,063	122,642,352	129,222,977	\$46,691,650

* Sources: (52 and 12—1/18/52, 1/23/53, 1/14/55, and 1/20/56).

Lily acreage seems small

The acreage of lilies is probably rather small since data are not reported in detail as they are for the other bulb crops. This conclusion is corroborated by data on exports to the United States which reached a peak of about 3 million bulbs in 1952 and subsequently declined to less than two million in 1955.

England buys the most

Holland exports a greater tonnage of

bulbs to England than to any other country, but in dollars, the United States is the Netherlands' best customer. Exports to both the United States and Canada reached their peak in 1953 and have declined slightly since then, while exports to Western Germany have increased rapidly. Holland's freezing weather in the spring of 1953 did not seriously affect the overall bulb export picture. Total exports in 1953 surpassed all records since 1950. (Table 17)

The

United Kingdom

The British Isles lead the world in narcissus acreage.

England grows bulb crops in two main areas. Lincolnshire grows primarily for bulb production (Fig. 8). The Southwest (Devon, Cornwall and Scilly Isles) generally grows for flower cutting. The peak year before the war was 1939 when 7,656 acres of bulbs were planted (4,473 of these were narcissus). By 1944 the total acreage had dropped to its lowest point of 1,846 acres. By 1954-55 the acreage had surpassed that of 1939, as Tables 18 and 19 show.

Sixty-seven per cent of the total acreage was grown for flower production

Table 18. Total bulb acreage in the United Kingdom (9)^a

Year	Number of acres
1939	7,656
1944	1,846
1950	5,345
1951	6,211
1952	6,679
1953	5,929
1954	7,173
1955	7,968

^a Data are for England and Wales, excluding the Scilly Isles.

Table 19. Acreage data for individual bulb crops in the United Kingdom (9, 30)

Year	Narcissus	Tulips	Misc.	Total
1940-41	2,926	1,667	402	4,995
1952-53	2,765	2,084	1,080	5,929
1953-54	3,938	2,327	908	7,173
1954-55	4,428	2,659	881	7,968

in 1954-55. Percentages by crop were: 72 for narcissus, 54 for tulips, and 79 for miscellaneous. Most of the domestic-produced bulbs are used for early forcing, with very few going into the retail or export trade. Export data are given in Table 20.

England imports heavily as shown in Table 21.

Disease and other problems are, in general, similar to those in Holland. However, certain tulip stocks in England have become infected with a bulb and stem nematode which is reportedly rare in Holland. This disease is similar to the one in daffodils. In 1951 the nematode was serious in certain stocks in Lincolnshire, England.

The disease is easiest to detect on flowers. Affected blooms are often set at an angle on the stem, and may be greenish on the side, with light white or yellow streaks on the stem just below the flower. The leaves may be split. Control tests with hot water treatments are being tried. This disease apparently is not yet established in the United States.

In prewar years the Isles of Scilly exported over 1000 tons of narcissus flowers. Narcissus growing was said to be the most important industry in the islands. During the same period Cornwall shipped over 5000 tons a year. Similar data are not given for Devon, but the major part of the daffodil acreage there is reportedly used for flower production. Fewer flowers are cut in Lincolnshire, where more bulbs are apparently grown for forcing.

Bulb fields in Lincolnshire tend to be larger than in the southern areas. A trend toward mechanization has modified the bed system commonly used elsewhere in England. A furrow is first opened and bulbs are planted by hand. They are next covered by plowing another furrow 9 inches away. Five or six such furrows are planted and then one space is skipped for a path. To harvest, the bulbs are plowed out or, more recently, dug with a potato-type digger.

Breeding new varieties, particularly daffodils, has always been a popular and occasionally a profitable pastime. To date

Table 20. Total exports from the United Kingdom in numbers of bulbs (9)

	1940	1952	1953	1954	1955
Total	18,514,000	2,119,000	4,212,000	nil	nil

Table 21. United Kingdom imports of bulbs, corms, tubers, and rhizomes in numbers of bulbs (9)

Type		1940	1952	1953	1954	1955
Narcissus	not		63,581,000	68,050,000	74,099,000	71,852,000
Tulips	available		131,705,000	146,324,000	150,881,000	152,178,000
Hyacinths	separately		18,375,000	21,387,000	22,086,000	23,564,000
Others	"		424,967,000	365,512,000	387,216,000	394,714,000
Total		4,127,000	638,628,000	601,273,000	634,282,000	642,308,000



Fig. 8. Tulip field in County of Lincoln, England. (Photo obtained by J. T. Page, Nat. Ag. Advisory Service, Boston and used by courtesy of the copyright owner, Lincolnshire Free Press.)

over 12,000 varieties have been named. The most popular daffodil, King Alfred (a tetraploid) was hybridized by John

Kendall, who died before it bloomed. It was introduced in 1899 by his sons who offered bulbs for sale at \$30.00 each.

The U.S. leads in bulbous iris, gladiolus, and lilies

Bulbs are grown in all parts of the United States in home gardens, but only in a few states for commercial purposes. Easter lilies are concentrated along the Pacific coast in northwestern California and southwestern Oregon, with a smaller acreage in the southeastern United States.

Gladiolus are grown for bulbs mainly in Michigan, Oregon, New York, Illinois and California, and for cut flowers primarily in Florida and North Carolina.

Bulb production of narcissus, bulbous iris and tulips is concentrated in the Pacific Northwest, particularly in Washington. North Carolina and the West Coast States grow narcissus for cut flowers.

The "Dutch type" bulbs (narcissus, bulbous iris and tulips) were previously grown extensively on Long Island, Michigan, New Jersey, Virginia, the Carolinas and Florida. However, various factors, particularly greater production and lower disease loss, gradually shifted most bulb production to the Pacific Northwest, as Table 22 shows. Additional economic data can be found in a report by Hill (23), the United States Census (47), and several publications by Fossum (including 19 & 21).

Several factors explain why Pacific Northwest bulb growers can partially withstand the competition from foreign bulbs produced with much cheaper labor and shipping (ocean freight from Europe vs. rail freight from the West to East coast markets). U.S. Northwest advantages are:

1. Mechanization
2. Cheaper land
3. Better natural curing conditions during the summer

4. And particularly, growing conditions that produce bulbs which flower earlier in the greenhouses and with generally larger flowers than those from foreign bulbs.

These latter features have enabled Northwest growers to capture and retain the market for bulbs for early forcing in greenhouses. Such bulbs naturally command a higher price than bulbs for later forcing, which are often from foreign sources. In recent years, trends away from greenhouse forcing and toward "dry sales" have affected returns to Northwestern growers. Early flowering is less important in the dry sale market. These trends are discussed later in more detail.

The figures in Table 22 for 1948-49 do not represent actual production. Since the Washington acreage is definitely known from State Department of Agriculture inspection records, an average figure can be obtained for number of bulbs sold per acre. This average is much less than State Department and growers' records indicate. Part of this difference can be attributed to the use of some acreage for flower cutting only, and to surpluses of unsold bulbs. Neither item would be incorporated in census returns. In addition, the census data did not include small operators; hence, the census data are only a general guide to production.

In 1956 the author tried to obtain acreage data or estimates from state agencies or bulb associations in the twelve leading states. Data were not available for several states, but these are believed to be of minor importance at the present time. Based upon the data

Table 22. Number of bulbs sold in the twelve leading states, 1929 and 1949 (46, 74)

State	Bulbous Iris		Narcissus ^a		Tulips		Gladiolus		Lilies ^b	
	1929	1949	1929	1949	1929	1949	1929	1949	1929	1949
California	671,446	28,700	4,016,915	1,362,651	12,950	0	13,878,027	12,974,925	699,784	1,924,350
Florida	0	0	4,360,965	500	100	0	952,350	2,066,550	60,400	41,955
Illinois	263,173	14,000	587,120	150,000	800	0	5,866,960	27,845,025	16,252	300
Indiana	870	0	300	50,000	2,390	180,000	14,109,703	6,585,113	26,064	0
Iowa	1,670	0	10,000	0	8,550	0	5,459,270	2,208,000	953	0
Michigan	180,511	768,750	1,484,380	1,675,000	372,543	3,104,440	34,083,608	59,687,814	12,346	74,749
Minnesota	1,538	0	0	45,000	75,000	125,000	5,748,501	3,186,740	12,000	10,000
New York	108,876	420,000	2,928,945	2,403,400	122,684	1,081,000	8,036,798	33,044,750	60,637	146,666
N. Carolina	96,000	157,900	493,900	907,000	55,000	15,980	451,260	7,861,650	197	0
Ohio	530	0	1,008	0	61,553	0	6,589,363	4,067,790	222,269	0
Oregon	307,449	3,916,150	5,518,002	6,369,891	1,004,417	150,760	19,559,615	40,213,800	151,207	4,780,143
Washington	5,731,846	15,230,362	16,836,463	12,231,170	612,057	7,292,420	3,871,733	3,257,550	904,612	336,477
Total U.S.	7,424,092	20,735,862	46,705,382	26,159,524	2,665,846	12,346,880	152,427,783	218,397,922	2,288,330	7,750,459

^a All types. Predominantly hardy in both 1929 and 1949, except for Florida and California.

^b All types. Mostly miscellaneous in 1929; and Easter lily types in 1949.

Table 23. Estimates of bulb acreage in the leading states listed in table 22^a

State	Acreage estimates for 1956			
	Narcissus	Bulbous Iris	Tulips	Total
California	270	75	10	355
Florida	50	—	—	50
Michigan	9	—	12	21
North Carolina	500	200	20	720
Oregon	480	45	23	548
Washington	838	333	267	1,438
Total	2,147	653	332	3,132

^a Estimates were obtained from state agencies or bulb organizations in the fall of 1956. Estimates of gladiolus acreage were: 11,600 for Florida; 1,000, Illinois; 800, Indiana; 4,000, Michigan; 1,500, New Jersey; 800, New York; 1,500, North Carolina; 712, Oregon.

obtained (Table 23), the total United States acreage was probably about 2500 for narcissus, 750 for bulbous iris, and 500 for tulips in 1956.

Data for New York are unavailable but the acreage is known to have decreased appreciably since 1949. The estimate for Michigan seems somewhat low, while that for North Carolina appears high. However, in the latter state most of the plantings are devoted to cut flower production and therefore, would not appear under "bulbs sold" in the census report for 1949 (Table 22).

Most field-cut bulb flowers grow on coasts

Most of the field-cut bulb (narcissus, iris, and tulips) flowers are produced in North Carolina on the east coast, usually in January and February. The west coast harvest starts in December or January in California at Encinitas and progresses north through Santa Barbara, Watsonville, Arcata, Brookings (Oregon), Umpqua Valley, Portland, Tacoma (Washington), Seattle, and finally, Mount Vernon.

The U.S. imports from twenty-five countries

U.S. Census bureau data (Table 24) show that over 442 million bulbs were imported from twenty-five countries into the United States in 1955. The declared value was almost 12 million dollars. (Table 25). Figures are given for several specific crops. Certain others such as bulbous iris and gladiolus are placed under miscellaneous, and are, therefore, unavailable, except by means of export figures from foreign countries. The Census Bureau usage is somewhat inconsistent. Thus, census data for "Lily-of-the-Valley Pips" are given, but their numbers are known to be much below those for

iris and gladiolus, according to other countries data on bulb exports destined for the United States.

More bulbs came from the Netherlands in 1955 than from any other country. Japan exported most of the lilies and Germany most lily-of-the-valley. Supplementing census data with export data from other countries (particularly from Netherlands), imports of bulb crops appear in the following sequence of importance in numbers in 1954: tulips, gladiolus, bulbous iris, narcissus, hyacinths, crocus, lily and lily-of-the valley.

Total imports increased rather steadily in post war years, reached a peak of 582 million in 1953 and then decreased. Decreased imports from Holland (particularly of gladiolus and iris) account for most of the slump. At the same time, imports from Japan have continued to increase, although not enough to offset the decrease from Holland. Noticeable shifts in imports of various crops are:

Tulips—Imports from the Netherlands reached a peak in 1953 and have declined slightly since then. Meanwhile, Japanese imports, although still small, have been increasing quite rapidly. Imports from other countries have fluctuated considerably, particularly those from Canada. It is interesting to note that imports from the Netherlands have only risen about 50 per cent since 1931.

Narcissus—Imports from the Netherlands, our largest supplier, have remained rather steady since 1947. France has increased exports since that date, while Italy increased up to 1953 and then decreased. Japanese exports are still minor.

Hyacinths—Imports of hyacinths have remained rather stable since 1949 with the majority of the bulbs coming from the Netherlands. Imports have increased only about 50 per cent since 1931.

Lilies—Imports have risen quite slowly since the end of the war and by 1955 were still only one-fifth as large as before the war. Before 1940, imports were predominantly "Gigs" from Japan. Bermuda, a large supplier before the Rosette Virus disease was introduced, has declined to negligible proportions. Netherlands exports have dropped since 1952. Those from Japan have been relatively stable since 1951, indicating that American lily growers (primarily of Croft variety) so far have been able to retain their home market.

Lily-of-the-Valley—Considerable variation in numbers and sources of imports have occurred with this crop. Germany and the Netherlands often seem to alternate; a large export in one year is followed by a smaller one the next year.

Crocus—The imports of this crop have been relatively stable, although tending to decrease slightly from a peak in 1948. The Netherlands is practically the only supplier.

Miscellaneous—Gladiolus and iris presumably make up the majority of miscellaneous imports. Thus, Dutch export data indicate that about 134,000,000 gladiolus and 28,000,000 iris were sent to the United States in 1954. This leaves only 30 million unaccounted for from the Netherlands and 63 million from all countries.

Data from Holland indicate that exports of gladiolus to the United States reached a peak of 178 million in 1953. The iris top was 72 million in 1952. Exports of both crops have declined appreciably since those years.

Unofficial data of Japan, the next largest supplier, indicate that gladiolus represent a large part of that country's miscellaneous item. In view of the importance of such crops as gladiolus and iris, it would seem very desirable for the Census Bureau to itemize them separately.

U.S. tariffs have come down

One of the many factors affecting competition between domestic and imported bulbs have been tariff rate. Various agreements have resulted in reductions as noted in Table 26. Lilies were the most recent crop to be affected.

America exports, even to Holland

Exporting bulbs from the United States to such countries as the Netherlands, seems like "carrying coals to Newcastle." Normally a few bulbs are shipped, probably of new varieties originating or propagated in the United States. The severe freeze in 1953 in the Netherlands reduced production. Exporters there ordered over one million Wedgwood iris bulbs from Washington growers to help fill 1955 contracts with European countries, particularly Sweden. The forcing performance of the bulbs was so good that Swedish forcers are reported to have placed subsequent orders directly or indirectly with Washington growers for iris bulbs. They prefer top size (11 or 12 cm.) bulbs.

Detailed U.S. export data are not available for individual bulb crops. However, the total numbers of bulbs, corms, tubers, rhizomes and roots exported in the years 1950 through 1955 are given in Table 27.

Total exports have remained approximately the same for six years. The major consuming countries were Cuba and Canada. However, exports to the Netherlands have increased considerably since 1953; probably most were iris. A monthly breakdown of the 1955 data shows that 25,000 bulbs were exported to the Netherlands in January; 20,000 in February; 660,000 in March; 27,992 in September, and 1,064,800 in October (48).

Table 24. U.S. imports for consumption of bulbs, corms, rhizomes, etc., by country of origin, in thousands (3, 49)

Bulb & Origin	1931	1939	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955
<i>Crocus</i>													
Netherlands	8,475	15,364	8,729	21,919	29,974	31,518	29,561	27,543	25,430	28,782	26,492	23,181	23,410
Total	8,675	15,389	8,747	21,919	29,974	31,541	29,561	27,543	25,434	28,806	26,501	23,395	23,504
<i>Hyacinth</i>													
France	372	658	—	137	244	430	352	435	369	252	111	229	216
Netherlands	19,328	19,174	8,368	17,527	16,363	19,184	22,472	23,841	23,276	24,582	26,426	26,868	26,822
Total	19,911	19,833	8,475	17,675	16,607	19,614	22,855	24,325	23,698	24,888	26,628	27,154	27,053
<i>Lily</i>													
Bermuda	673	211	600	357	213	155	128	105	50	27	21	59	8
Japan	14,936	22,089	0	0	179	632	1,857	2,067	2,909	2,947	3,062	3,121	2,970
Mexico	0	0	1,664	880	308	105	21	0	0	0	0	0	0
Netherlands	591	1,478	612	1,841	1,426	797	2,197	2,080	2,295	2,875	2,368	1,885	1,730
Total	17,466	24,305	2,984	3,299	2,311	2,173	4,636	4,584	5,768	6,285	6,047	5,431	5,053
<i>Lily-of-the-Valley</i>													
Denmark	61	0	0	26	42	155	235	80	757	358	794	584	351
Germany	12,058	4,924	0	0	2,275	2,471	700	2,856	1,125	761	808	816	2,108
Netherlands	237	294	62	162	28	1,657	467	1,015	1,964	933	528	2,038	831
Total	12,450	5,218	62	188	2,346	4,283	1,431	3,951	3,846	2,096	2,130	3,437	3,343
<i>Narcissus</i>													
France	0	12	27	10	26	5	1,128	2,157	2,218	1,595	1,106	1,958	2,155
Italy	0	0	0	0	0	73	329	858	1,224	1,520	1,574	634	419
Japan	0	8	0	0	0	0	0	0	0	4	0	20	64
Netherlands	1,045	11,334	11,464	31,915	24,565	21,311	21,885	23,441	21,602	25,089	27,621	25,011	24,287
Total	1,086	11,382	11,504	31,951	24,597	21,395	23,400	26,496	25,064	28,279	30,308	27,803	26,948
<i>Tulip</i>													
Belgium	0	0	0	32	0	0	2,103	1,117	582	462	450	1,259	250
Canada	453	0	214	80	91	1,417	981	690	4	177	0	229	0
Denmark	0	0	0	0	0	0	0	0	0	1,800	525	1,400	1,015
France	126	154	294	53	137	228	257	127	636	271	139	212	574
Japan	0	1,207	0	0	0	290	475	706	901	956	1,286	2,900	5,421
Netherlands	120,283	110,985	50,598	100,160	95,377	104,072	121,776	131,534	138,311	162,103	168,646	161,664	160,838
Total	120,864	112,346	51,187	100,328	95,993	107,273	128,957	136,290	140,966	165,954	171,308	167,735	168,157
<i>Miscellaneous</i>													
Belgium	0	233	613	2,283	3,159	5,654	5,488	9,517	9,781	13,103	16,757	12,412	11,578
Japan	7	9	0	0	0	0	83	891	4,824	3,434	10,164	13,307	15,281
Netherlands	6,254	23,152	14,165	77,448	66,344	70,738	150,065	214,934	260,957	288,692	284,285	191,929	152,993
Total	6,432	23,942	25,551	89,479	86,129	80,084	170,812	229,346	281,102	310,301	318,590	225,206	188,810
Total—All Netherlands	168,035	181,781	93,998	250,972	234,077	249,277	348,423	424,388	473,835	533,056	536,366	432,576	390,911
Total—All Japan	15,004	23,313	0	0	179	922	2,415	3,664	8,634	7,361	14,532	19,358	23,736
Total—All Countries	186,883	212,415	108,510	264,839	257,957	266,363	381,652	452,535	505,878	566,609	581,512	480,161	442,868

Table 25. Consolidated data on imports of ornamental bulbs from all countries, 1955 (49)

Crop	Country	No. bulbs	Total value	Value per bulb
<i>Crocus</i>				
	France	94,400	\$ 1,582	\$.016
	Netherlands	23,409,601	395,946	.016
Total		23,504,001	397,528	.016
<i>Hyacinth</i>				
	France	215,890	15,744	.07
	Italy	6,000	257	.04
	Netherlands	26,822,317	1,836,821	.068
	United Kingdom	9,225	931	.10
Total		27,053,432	1,853,753	.068
<i>Lily</i>				
	Belgium	3,119	360	.115
	Bermuda	8,100	1,840	.227
	Canada	2,463	3,863	1.56
	Denmark	10,000	385	.038
	France	208,309	20,759	.099
	Italy	118,520	6,374	.053
	Japan	2,969,967	222,073	.074
	Netherlands	1,730,336	105,801	.061
	Turkey	2,000	400	.20
Total		5,052,814	361,855	.071
<i>Lily-of-the-Valley</i>				
<i>Pips</i>				
	Denmark	351,000	14,127	.04
	Italy	53,000	2,466	.04
	Netherlands	830,600	15,029	.018
	West Germany	2,108,325	86,719	.041
Total		3,342,925	118,341	.035
<i>Narcissus</i>				
	France	2,155,150	73,300	.034
	Ireland	10,524	1,733	.16
	Italy	419,150	10,350	.024
	Japan	63,700	789	.012
	Netherlands	24,286,674	1,114,508	.045
	Switzerland	4,646	350	.075
	United Kingdom	8,004	2,684	.335
Total		26,947,848	1,203,714	.04

(Cont.)

Table 25 (Cont.)

Crop	Country	No. bulbs	Total value	Value per bulb
<i>Tulip</i>				
	Belgium	250,000	1,740	.006
	Chile	21,600	254	.011
	Cuba	1,316	5,264	4.00
	Denmark	1,015,000	6,662	.006
	France	574,325	15,763	.027
	Japan	5,421,240	68,098	.012
	Netherlands	160,837,536	5,229,357	.03
	New Zealand	6,000	252	.042
	United Kingdom	30,465	1,153	.037
Total		168,157,482	5,328,543	.03
<i>Miscellaneous bulbs, corms, rhizomes, etc. (including Iris and Gladiolus)</i>				
	Australia	25	333	13.32
	Austria	77,000	4,664	.06
	Belgium	11,577,772	637,935	.055
	Burma	8,515	845	.099
	Canada	393,560	13,533	.03
	Columbia	12,180	746	.06
	Denmark	4,682,300	16,430	.003
	France	89,300	1,734	.019
	Germany—East	41,500	2,398	.057
	Germany—West	85,295	3,212	.037
	India	22,740	571	.025
	Israel	1,614,696	18,878	.011
	Italy	334,690	9,580	.028
	Japan	15,280,660	75,570	.0049
	Mexico	1,076,045	7,549	.007
	Netherlands	152,993,377	1,689,309	.011
	Turkey	220,500	3,642	.016
	U. So. Africa	243,000	3,845	.015
	United Kingdom	57,340	2,723	.047
Total		188,810,495	2,493,497	.013
Total, 25 Countries		442,868,997	\$11,757,231	\$.026

Oregon leads in lilies

Oregon leads the United States in acreage devoted to lilies. The Croft Easter lily is the predominant type, although many other species and varieties are grown in large quantities. The acreage increased quite rapidly soon after the war and then relapsed slightly (Table 28). The peak was reached in 1946-47 with 965 acres, but a price break late in 1946 forced many growers out of business the following year.

Both garden and forcing types have contributed to a recent increase. The largest lily farm in the United States is probably the Oregon Bulb Farms at Gresham, Oregon. Most garden types are raised near Portland and the Easter types along the southern Oregon coast. Adjacent areas along the northern California coast also raise 122 acres of Easter lilies.

The narcissus acreage was greatest in 1953, but since then it has dropped rather drastically. Over one-half of this planting is in northern Oregon, near Portland. About 45 acres are located near Salem, with the remainder scattered along the coast. The latter plantings are devoted primarily to flower cutting.

Most of the tulip acreage has been centered in the Portland area, but this crop has never been as important as narcissus. Part of the present acreage is used for cut flowers.

The total iris acreage reached a top of 200 acres in 1950 and has remained slightly below that level since that year. Originally the bulbous types were predominant, but now rhizomatous iris represent about three-fourths of the total. Most of the acreage is in the Portland area, with a smaller amount near Salem.

Although gladiolus are raised in all

Table 26. Changes in U.S. tariff rates since 1930 (2)

Flower	Rate per 1000 bulbs	Effective date
Hyacinth	\$4.00	6/18/30
	2.00	1/1/48
Lily	6.00	6/18/30
	4.50	6/6/51
Tulip	3.00	7/24/55
	3.00	2/1/36
Narcissus, ^a	2.00	6/6/51
	15%	2/1/36
iris ^a	10%	1/1/48
and gladiolus ^a	7½%	6/6/51

^a Ad valorem

areas of western Oregon, about one-half of the acreage is located near Portland, one-fourth around Grants Pass, and the remainder is scattered. Flower cutting is quite common, particularly in the Portland area.

Accurate data on bulb flower cutting are not available, according to Clark (7). He reported the following approximate annual data for field-cut flowers of all types for the years 1950 through 1956: 648, 635, 651, 887, 704, 731, and 686 acres. This acreage likely includes a considerable area from which bulbs are also sold.

Of the miscellaneous crops, dahlias are one of the leaders. Other smaller crops are daylilies, montebretias, and hyacinths.

The data on returns per acre indicate that in 1949 iris were the best money-makers, followed by lilies and gladiolus. However, in interpreting these data, remember that income from many crops has dropped since that date.

Oregon culture methods are similar to those used in Washington.

Table 27. Exports of ornamental bulbs, corms, pips, tubers, rhizomes and roots from the U.S.—number, and declared value, 1955 (48)

Major countries	1950	1951	1952	1953	1954	1955	Value in 1955
Canada	13,406,266	12,814,290	8,429,128	9,008,278	8,245,155	11,012,108	\$586,603
Cuba	4,099,211	6,128,145	7,676,977	9,231,584	10,412,956	8,053,265	136,160
Netherlands	23,250	63,467	26,200	307,650	908,309	1,797,792	23,804
Total, all countries	19,168,408	20,204,756	18,058,990	19,557,192	21,317,245	23,975,891	908,544

Table 28. Oregon bulb acreage (6, 7, 11)

Type	Average 1936- 1939	Average 1940- 1944	Average 1945- 1949	1949	1950	1951	1952	1953	1954	1955- 56	1956- 57	Income per acre in 1949
Narcissus	438	537	663	750	779	685	783	837	725	480	473	\$ 580
Iris (mostly rhizome)	62	109	144	175	200	188	176	174	176	175	178	2,469
Tulips	60	109	69	30	63	41	41	39	28	23	18	833
Gladiolus	567	432	531	645	753	701	815	736	767	750	712	1,527
Lilies	70	174	783	750	646	577	566	597	688	723	677	1,563
Miscellaneous	58	48	74	105	132	132	132	141	158	145	142	1,238
Total	1,255	1,409	2,264	2,455	2,573	2,324	2,513	2,524	2,542	2,296	2,200	\$8,210

Washington

The evergreen state leads the U.S. in bulbous iris, narcissus, and tulip production

The Washington bulb industry is young. Most of its growth has taken place in the past thirty years, although a few bulbs were raised as early as 1900. Yet in 1950, Washington led all other states in the production of daffodils, tulips, bulbous iris, and hyacinths. It was third in the production of Easter lilies and tenth in gladiolus, according to census reports. Washington's bulb production would fill about 160 freight cars in a normal year.

The industry began on a hand-labor basis, using the Dutch bed system. However, the growers soon began mechanizing, and are still doing so. Without such mechanization, Washington bulb growers could no longer compete with those of Holland, whose labor costs run as low as 27¢ per hour. Washington labor rates are \$.85 to \$1.50 an hour.

With mechanical planters and diggers, growers can plant and dig two to five times faster than by hand. Growers have mechanized other operations, including spraying, weeding with chemicals, and cleaning bulbs. However, the increased cost of labor, equipment, materials and freight have cut net returns to the growers. This condition is reflected in a steadily decreasing acreage in Washington since 1948-49.

Washington's bulb acreage reached its peak in 1948-49 with a total of 2155 acres and declined to 1597 acres in 1955-56. Daffodil growing reached an all-time high in 1929-30 with 1444 acres and a second peak of 1120 acres in 1948-49. Since then the acreage has dropped



with some fluctuations to 838 acres in 1955-56. Although daffodils have been considered a rather stable producing crop, they have had a comparatively low net return. Daffodil growing has been plagued by a surplus (Table 29).

Tulips reached their apex of 395 acres in 1947-48 but dropped below the 300 mark in 1950 and have stayed there ever since. Some growers say that tulips are generally a money-losing proposition in western Washington.

On the other hand, many growers consider tulips a necessity, because a selection of different types of bulbs helps when selling. An unsolved problem with this crop is the cause and cure of thin skins. Thin skins tend to split and sometimes break off.

Because of continuing favorable prices, iris production kept climbing until 1951-52—later than the other bulb crops. The 1952-53 acreage was only slightly lower than the preceding year. However, the

fall of 1952 brought several distress sales because of heavy Dutch imports (up to 72 from 48 million in 1951). Consequently in the spring of 1953, when it appeared that both Holland and the United States would have large crops, all but a very few Washington iris growers voluntarily reduced their crops by 20 per cent.

This reduction helped ease the situation some. In addition, Holland had a severe freeze in 1953 and suffered such a large loss that their iris acreage has not yet regained its former level.

Iris are more of a gamble than are narcissus. In one very favorable year, one Washington grower sold \$8,000 worth of Imperator bulbs from one acre. In other years the returns have been too low to pay the cost of operations. However, modern knowledge and proper use of sprays, dips, irrigation, etc., gives at least

fair insurance of a successful crop, except for such unpredictable disasters as severe freezes.

Two major and more or less uncontrollable factors still play important parts in production and in forcing performance of iris bulbs:

1. Excessive rain during the winter which causes a high water table, especially on heavy soils on poorly drained sites.
2. Cool, wet summers such as occurred in 1954 and 1955, when even artificial heat curing could not compensate completely for the lack of natural curing conditions in the field before digging.

Lily growing never did become established in Washington as well as it did in southern Oregon and the adjacent California coastal areas. The acreage now is about one-half that of the late 40's.

Table 29. Washington bulb acreage (16, 17)^a

Year	Narcissus	Tulips	Bulbous Iris	Lilies	Gladiolus	Misc.	Total
1927-28	933	60	12	—	—	—	—
1928-29	933	45	48	—	—	—	—
1929-30	1,444	30	70	—	—	—	—
1930-31	1,288	20	116	—	—	—	—
1931-32	1,268	30	100	—	—	—	—
1932-33	1,133	40	100	—	—	—	—
1933-34	1,066	40	133	—	—	—	—
1934-35	1,200	30	60	—	—	—	—
1943-44	703	247	247	—	—	—	—
1947-48	1,030	395	300	110	115	50	2,000
1948-49	1,120	350	410	105	120	50	2,155
1949-50	1,015	290	405	110	118	55	1,993
1950-51	904	226	424	112	120	50	1,835
1951-52	960	226	428	102	100	51	1,867
1952-53	809	294	414	95	100	51	1,762
1953-54	864	283	339	90	85	55	1,716
1954-55	875	250	322	85	65	58	1,655
1955-56	838	267	333	64	50	45 ^b	1,597

^a Data are rounded off; consequently, some totals differ slightly from sum of the individuals. Acreage data for 1928 to 1935 are based upon conversion of inspection reports giving number of bulbs planted, using 45,000 per acre for narcissus; 300,000 per acre for iris; and 100,000 per acre for tulips.

^b About 12 of these were in hyacinths and 1½ in crocus.

The gladiolus acreage has also declined to less than one-half its post-war peak. The remaining plantings are mostly devoted to a combination of corm and cut-flower production. The area given over to miscellaneous bulbs has remained rather steady, with hyacinths showing a slight increase.

The field-cut bulb flower business grows

Some field-cut flowers have always been produced in the Northwest, but did not become big business until a few years ago. In recent years some growers have occasionally made as much from field-cut flowers as they have made from bulb sales under surplus conditions. More blooms are cut from daffodils than from any other bulb crop.

Some complaints have been made that such flowers compete with Washington grown bulbs sold for greenhouse forcing. Actually, Washington field-cut blooms usually come on the market from March 15 to April 15. This period is well after the marketing time of flowers produced in greenhouses from Northwest bulbs (Dec. 20-Feb. 15). Field flowers do not therefore compete directly with blooms from forced bulbs.

Eade found that flowers were not cut on about 200 acres of narcissus. On the remaining acreage, data supplied by certain growers indicated that the salable cut per acre ranged from 10,000 to 50,000 flowers. The average was about 30,000. The total cut is somewhat larger, since the figure does not include surplus flowers dumped by either the grower or by the jobber. Eade's data show that the number of flowers cut has apparently remained rather steady for the last five years, but returns to growers have dropped. (Table 30)

If markets are favorable, the daffodil flower price in Washington starts about \$10-\$12 per thousand, but soon drops as

more flowers reach the market. Much depends upon the timing of Easter and Decoration holidays. Occasionally, late production in Oregon and northern California affects Washington markets.

Average returns during the past two years were around \$6.50 per thousand. The price often drops lower, but many growers then quit picking, because they believe that it costs them \$4 to \$5 to pick and pack, without any return for cost of bulbs, etc.

In this connection, Kalin (25) reported that flower cutting reduced bulb yield by 4 to 10 per cent and that "the weight of bulbs planted influences the number of forced flowers that can be expected." Therefore, if bulbs of the usual size and weight are used for forcing, the flower production from them should be normal. It should also be pointed out that there has been a surplus of daffodil bulbs in the last few years—so some growers have replanted their extra bulbs primarily for flower production purposes. Even though the net return from flower cutting may be low, it provides a means of using labor more efficiently in the spring and also serves as a source of revenue to obviate borrowing money for other operations during the spring months.

Thus, the problem of whether or not to cut flowers becomes a complex one of balancing increased revenue and other factors against added costs and reduction in bulb yield. Bulb production costs are about the same, whether flowers are picked or not. Therefore, any return much greater than the cost of picking and handling flowers increases total per acre gross income, less the loss from a slight reduction in bulb yield.

An estimated 90 per cent of Washington's flowers are shipped out of the state. Flowers go both by refrigerated truck and by air—especially in chartered planes. Apparently, 1947 was the first year that a plane was chartered in Wash-

Table 30. Estimated field cut of narcissus flowers in Washington (16)

Year	No. of flowers	Average price per thousand
1951	21,120,000	\$10.34
1952	22,800,000	7.14
1953	18,000,000	7.73
1954	19,920,000	6.51
1955	20,250,000	6.63

ington for flower shipments. Incidentally, if all of Washington's daffodils were shipped by air in DC-3's, it would require about 40 to 50 flights to carry all the flowers.

Most flowers are sent to Chicago and other large metropolitan areas in the west and midwest. However, in times of good production and high prices, flowers may get to New York City and other eastern cities.

Several promotional methods are used to move flowers. One florist, who reportedly sold 1,000,000 daffodils within three weeks in 1953, advertised: "Fifty King Alfred daffodils shipped anywhere in the United States; \$2.85, postpaid." He made shipments in an attractive box with cards, etc. (38).

Average farm size is up

The bulb industry is concentrated near Tacoma and Mount Vernon, plus one large farm at Woodland. Most of the acreage is in farms of 10 to 100 acres, but four farms had 100 to 200 acres in bulbs in 1955-56. The average farm size has tended to increase in recent years, partly because small growers are quitting.

In 1933 there were 152 growers of narcissus. They planted over 51 million bulbs of 394 varieties on 1133 acres, according to Washington State Department of Agriculture records. Eleven of these growers planted over one million bulbs each.

Production tended to concentrate. In 1947 only 64 farmers were growing narcissus, although the total acreage planted

was about the same. In that same year, there were 34 iris growers and 42 tulip growers. Since many growers raised more than one type of bulb, the total number of growers was 80. In the same year there were 178 lily growers.

By 1956 (1955-56 season) the production was apparently still more concentrated, although data on a few small growers are unavailable. Washington had about 57 narcissus, 27 tulip, and 32 iris growers, or a total of 67 in all. Available statistics are in Table 31.

Bulb yields vary greatly

Production varies considerably, depending upon weather, soil, quality of stocks, etc. Yields of one of the more competent growers on a medium-sized farm during the past seven years are shown in Table 32.

The years 1955 and 1956 were poor for both Wedgwood and King Alfred. Variation in fields of Wedgwood is particularly great and is typical, according to other growers. The poorest years for tulips apparently were 1953 and 1954. The amount of flower cutting was both variable and unknown and was probably a major factor in reducing bulb production.

Table 33 gives estimated total production per acre of salable bulbs of different sizes. This figure is an average of estimates from several growers, and assumes the planting of good stocks in an average year without flower cutting. A relatively few smaller bulbs of each type are usually used for dry sales.

Table 31. Approximate number of growers, size of plantings, and leading counties in Washington in 1955-56 (17)

Size in acres	Number growing				
	Narcissus	Tulip	Iris	Hyacinth	Total
1—9	34	17	21	6	33
10—24	14	7	6	0	18
25—49	5	3	4	0	10
50—99	2	0	0	0	2
100—200	2	0	0	0	4
Total	57	27	31	6	67
Total No. acres ^a	838	267	333	12	1,450
Average acreage per grower	15	10	11	2	22
^a County		Acres			
Pierce	558	80	130	½	768½
Skagit	167	153	148	11½	479½
Cowlitz	90	30	41	0	161
Others	23	4	14	0	41

^a Excluding gladiolus, lilies and miscellaneous.

Table 32. Variation in yield of top sized bulbs, as percentage of total salable bulbs, 1950-56 (53)

Crop	Size	1950	1951	1952	1953	1954	1955	1956	Total average percentage
King Alfred	DN. 1	82	87	86	70	76	64	58	74
Wedgwood	10 cm.								
	& up	44	34	52	50	55	19	25	41
Tulips ^a	12 cm.								
	& up	91	98	69	40	41	53	53	56

^a Flower cutting was heavy in certain years.

Table 33. Estimated Washington average production per acre of good stocks under good growing conditions.

Crop	Size	Number	Size	Number	Size	Number	Total	Estimated gross returns ^b
King Alfred Narcissus	DN1	12,500	DN2	5,000	0	0	17,500	\$ 825
Wedgwood Iris ^a	10 & up	30,000	9-10 cm	30,000	8½-9 ^a	25,000	85,000	1895
Tulips ^a	12 & up	25,000	11-12 cm	25,000	0	0	50,000	1325

^a Circumference in centimeters.

^b Based upon 1956 average prices.

Other sources of production data are reports to the State Department of Agriculture of number of bulbs sold by growers. Data are presented for two years (Table 34). The numbers shown in Table 34 are known to be low for three reasons.

1. An estimated 5% of the smaller growers failed to make reports
2. Surplus bulbs that were dumped or replanted were not included
3. Bulbs planted for flower production were not included.

Washington growers have mechanized

Most bulbs in the Northwest are grown in rows, to facilitate the use of mechanical equipment. Without the latter, growers could not compete with the cheaper hand labor abroad.

The soil is acid and, generally, a sandy loam, although some peat and silt soils are used. The soil is worked up well. Most plantings are made in August or September, starting with daffodils and finishing with tulips.

Much of the planting is done with specially constructed machines. From large hoppers the bulbs are fed by gravity flow or by belts into a chute and then fall into the furrows (Fig. 10). These furrows are opened up by blades. Protective shields on the sides of the

blades keep the furrows from refilling with soil before the bulbs are planted. Bulbs are covered by dragbars or discs.

The bulbs are not usually set upright, but where they are (as with King Alfred mother bulbs), boys or men do the job while riding a platform back of the chutes. Of course, where daffodils are set upright, planting takes longer, whether by machines or by hand. Growers plant two to four rows at one time.

Though it takes four to five man-days to plant an acre of iris by hand, the task only requires one man-day by machine. With machine planting it only takes one man-day per acre of tulips and two per acre of daffodils. Hand planting either crop requires about four man-days per acre.

Rows are hilled periodically for weed control until late in the fall when chemical sprays are applied. This hilling also facilitates drainage and supposedly reduces freezing injury. The sprays suppress weeds until spring when the soil dries out enough to permit cultivation and/or post emergence sprays.

At regular intervals growers spray fungicides to control leaf blight on tulips and iris, starting as soon as tractors can get into the fields (Fig. 11). Usually it is not necessary to spray daffodils as often as the other crops.

Table 34. Average number of bulbs sold per acre in Washington for 1953-54 and 1954-55 (16)

Crop	1953-54			1954-55		
	No. acres	No. bulbs sold	Av. bulbs sold per acre	No. acres	No. bulbs sold	Av. bulbs sold per acre
Narcissus	864	12,800,000 ^a	14,815	875	12,300,000 ^b	14,057
Iris	339	22,292,950	65,761	322	21,337,600	66,266
Tulips	283	7,340,550	25,938	250	6,173,232	24,693

^a 12,717,675 + 6½ tons of field run.

^b 12,133,727 + 13 tons of field run.

Periodic cultivation is, of course, handled by machinery. Even some of the topping or flower removal has been done by modified mowing machines with blades raised high enough to clear the leaves. The cut flowers fall onto a moving belt that dumps them into a hopper.

Daffodils usually bloom early in April, tulips about the end of April, and iris the middle of May in the Puyallup Valley. The exact time depends on the weather.

Roguing is one operation which must be done by hand. Roguing is the removal of off varieties (rogues) and of diseased plants. This operation requires considerable training and takes much time, because every plant must be examined. Roguing may require more than one trip through the field because different diseases appear at various times in the season.

Irrigation is increasing. Rainfall in May and June is often too light for maximum production. This was proved conclusively in British Columbia by Crossley (10). When water was applied during the critical months, beginning in May, yields increased from 37 to 204 per cent (see Table 35).

Table 35. Percentage increase in yield from irrigation in British Columbia (10)

Crop	No. top size bulbs	Total weight
Hyacinth	63%	17%
Iris	37%	30%
Narcissus	204%	17%
Tulip	87%	18%

Digging is the worst bottleneck in bulb culture in the Northwest (Fig. 12). Digging cannot start until the plants are matured, but must be completed rapidly

in order to ship the bulbs to waiting dealers. Depending on the weather, digging usually starts at Puyallup late in June for tulips, early in July for daffodils and late in July for iris.

Hand digging takes about nineteen man-days per acre of iris, but with one type of machine the job requires but two man-days. (With hand digging, bulbs are plowed out and picked up by hand.) Comparable data for daffodils are twelve man-days by hand and five by machine. However, machines vary considerably in efficiency. Four different iris growers estimated that it took them two, six, twelve and sixteen man-days with their respective machines. In general, iris and daffodils can be dug mechanically with about one-third of the labor needed by hand.

The digging machines, like the planters, are individually designed and constructed by the growers. Machines are patterned after the potato diggers. An independently controlled sharp blade or rotating disc cuts off the leaves and removes soil above the bulbs. Next, a flat blade scoops up the layer of bulbs and adjacent soil onto a link belt (open potato-type for daffodils and closer type for iris and tulips). The belt removes loose soil by shaking. The bulbs are next dumped gently onto a moving belt along which operators are stationed to remove clods and stones. The bulbs finally drop into trays which are stacked at intervals in the field. There the bulbs dry before being moved to the sheds. Digging machines, which can dig 1 or 2 acres per day, may measure as long as 40 feet, when tractor length is included.

The weather usually allows rapid field drying of the bulbs in covered stacks of trays (Fig. 13). After drying, bulbs are removed to sheds. Tulips are then stored in rooms at about 70°, but Wedgwood iris are cured 10 days at 90° and then stored in open or semi-open sheds.

Daffodils are cleaned in modified potato cleaners, using rubber rolls. These machines can process up to 75,000 bulbs per day. Iris are handled similarly, but may require some hand cleaning in addition. Tulips, more easily bruised, are often cleaned by hand.

Most of the grading of iris and tulips is done in Dutch type machines handling up to 250,000 bulbs per day (54). (See Fig. 14.) Daffodils are usually graded by hand, although some large growers do a preliminary sorting with a modified potato grader. In all cases, counting and the removal of cut, offshape, or diseased bulbs requires much hand labor.

Growers pack tulip bulbs for sale in punched paper sacks or cardboard boxes, but pack iris in mesh sacks. These containers are then placed in slotted crates. Daffodil bulbs are packed loose in such crates (Fig. 15). Before shipping, the bulbs are usually fumigated with methyl bromide to control insects.

Most shipments to eastern states go in un-iced refrigerator cars, but trucks often carry those on the west coast. Upon receipt, jobbers or forcers give the bulbs for early forcing a pre-cooling treatment, such as six weeks at 50°, before planting and forcing.

Meanwhile, growers are planting for the next year's crop. Large daffodil farms may dig, clean, grade, and plant various crops simultaneously. Planting stock may or may not be graded.

If certain diseases or insects are a problem, growers dip the bulbs in fungicidal or insecticidal solutions. Small lots are dipped by hand. Several tons are often dipped at a time, using electrical hoists and large tanks. Bulbs are usually dipped in regular bulb flats so that the containers are disinfected along with the bulbs.

Bulb or stem nematodes are controlled by treating the bulbs for three to four

hours in 110° F. water to which formaldehyde is added. Fumigation with methyl bromide—sometimes a half million bulbs at a time—also controls certain insects.

Some species of fungi and insects may survive in the soil for several years. However, recently developed soil treatments now permit growers to re-use such infested land. Such treatments, coupled with sprays and roguing, have enabled the growers to almost entirely eliminate many serious pests, but the fight is never-ending, and requires considerable care and experience.

Bulb growing is, therefore, a highly specialized type of farming. It requires high intelligence, much experience, and a large capital investment for specialized machinery, and other types of equipment. Machinery and equipment seldom fit other crops and, therefore, have a low resale value. Because of this, or perhaps in spite of it, the turnover of growers is relatively low. Apparently, growers love their work—as evidenced particularly by the large collection of bulb varieties which many of them maintain, even though the income from the collections seldom justifies their expense.

Washington began about 1900

Although a few bulbs were being grown about 1900 by John McRae Smith in Bellingham, 1908 was the principal starting point of bulb growing in western Washington. In that year the United States Department of Agriculture established a "bulb garden" or experiment station at Bellingham and planted 170,466 bulbs.

This site was one of several selected after surveys in 1906 and 1907 throughout the United States for locations with conditions comparable to those existing in Holland. A USDA publication (37) states that the experiment station was established "in order to encourage the growing of Dutch bulbs in this country

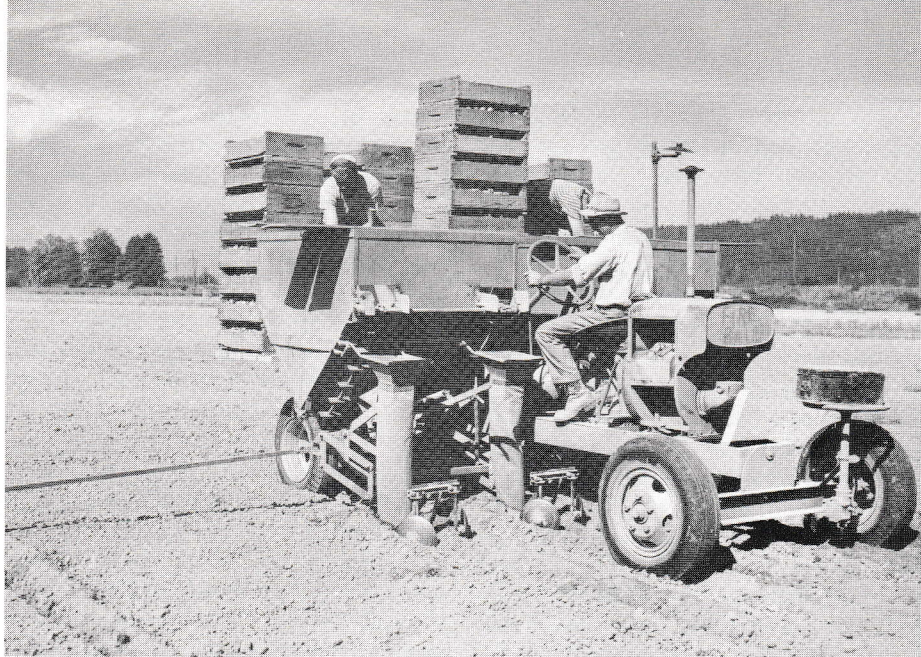


Fig. 10. This machine is planting daffodil bulbs about twice as fast as hand planters could go. Tulips can be machine planted about four times as fast as by hand. (Photo courtesy of Lee Merrill, Tacoma, Washington.)

Fig. 11. Spraying daffodils for disease control near Orting, Washington. Growers spray tulips and iris with fungicides at regular intervals. Daffodils do not usually have to be sprayed as often. (Photo courtesy of Lee Merrill, Tacoma, Washington.)



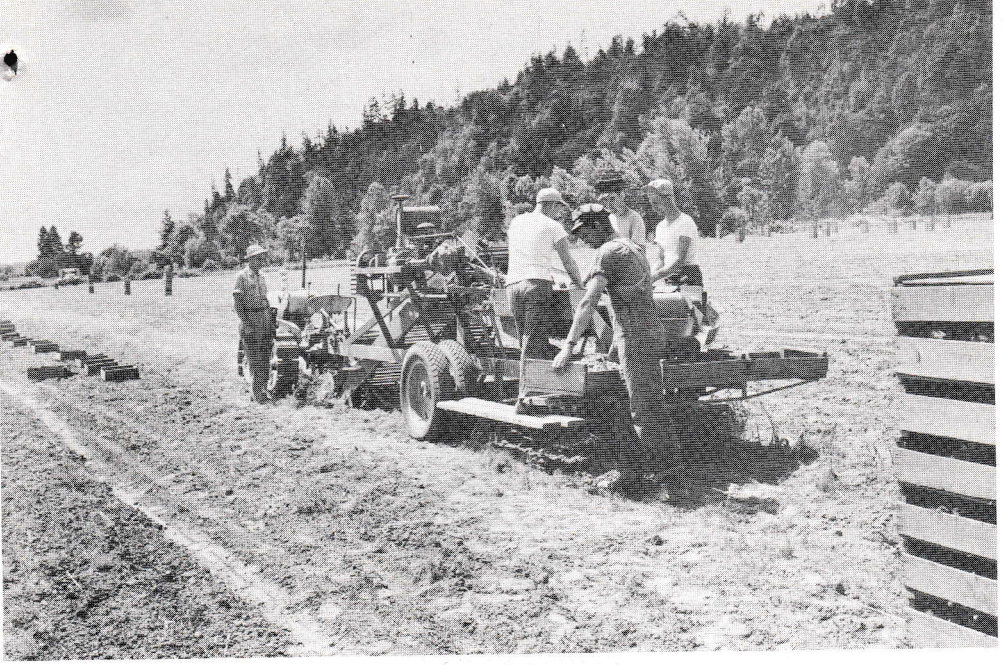


Fig. 12. Bulbs must be dug rapidly. The amount of labor saved varies with the kind of bulb and type of machine. In general, machine digging uses about one third as much labor as hand harvest. The picture shows daffodil digging in Washington. (Photo courtesy of Lee Merrill, Tacoma, Washington.)

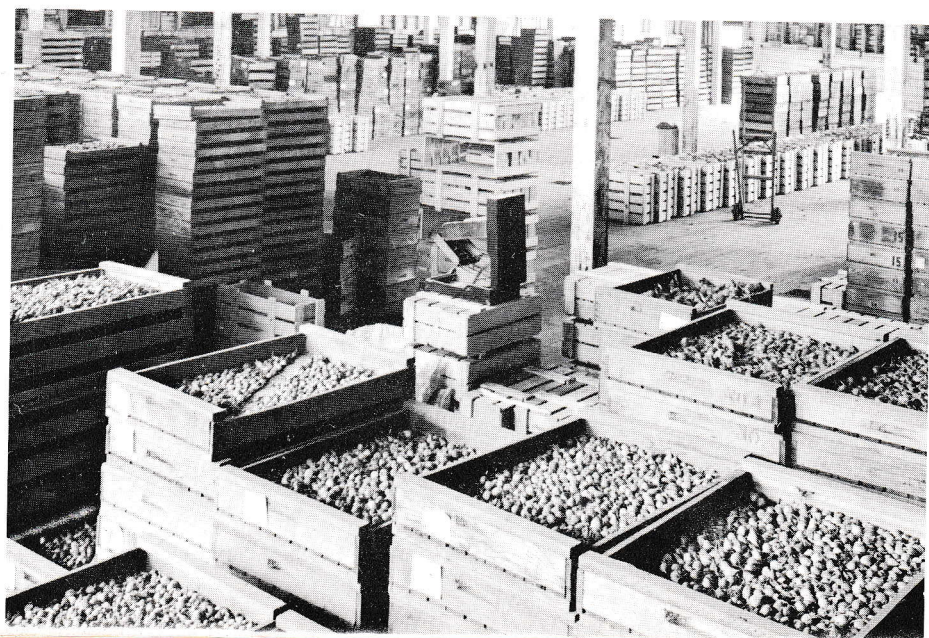
Fig. 13. Daffodils are being cured in stacks of trays in the field. (Photo courtesy of Lee Merrill, Tacoma, Washington.)





Fig. 14. Bulb grading is also done with the help of machinery.
(Photo courtesy of Lee Merrill, Tacoma, Washington.)

Fig. 15. These bulbs are awaiting packing or shipment in a warehouse at Sumner, Washington. (Photo courtesy of Lee Merrill, Tacoma, Washington.)



on a commercial scale and to provide American-grown bulbs of superior quality for congressional distribution." By 1912 over a million bulbs were being grown at the Bellingham station.

Although Dr. David Griffiths did not take over direction of the station until later, he should be considered the "God-father" of bulb growing in the Pacific Northwest. He grew bulbs in many parts of the country under different conditions, and tested them in greenhouses at Washington, D.C. Griffiths published his results in several bulletins that still serve as guides to growers.

After his death in 1935, the Bulb Garden in Bellingham was discontinued and converted into a Soil Conservation Service Nursery. By that time Griffiths had demonstrated that the Pacific Northwest was a choice location for growing daffodils, tulips, bulbous iris, and lilies.

Meanwhile, the bulb industry in western Washington was expanding. By 1918 several growers were raising bulbs for field-cut flowers. One of these was Joe Smith, near Olympia. Another, and one of the largest, was George Lawler near Tacoma. Starting in 1910, he grew more flowers than the local florists could handle in 1918, so he started selling directly to the public through street vending—a common sales method today.

Daffodil growing for the sake of bulbs instead of flowers was stimulated by a requirement of the United States Department of Agriculture which went into effect January 1, 1926. In announcing the regulation, made under Quarantine 37, the Department of Agriculture stated on Dec. 22, 1922 that: (50) "Information derived through inspection of import shipments of bulbs since 1919 indicates that there is a considerable element of danger in such importations in that they carry insect pests, the risk of establishment of which in this country cannot be entirely eliminated by inspection and

disinfection. That risk increases directly with the volume, variety, and diversity of origin on the imports. Continuance of this risk through such imports is, therefore, only justified for such reasonable time as may be required to establish the commercial production of the several important species of bulbs in this country."

A domestic quarantine (#62) was placed on narcissus also in 1926 "as an additional safeguard to prevent further distribution of these pests (nematodes and insects) in this country, all shipments of narcissus bulbs imported under permit in limited quantities for propagation purposes were given hot water treatment under the supervision of inspectors of this (U.S.D.A.) Department" (50).

Early growers

In order to supply the American market, certain Holland firms sent both stocks and some growers to the Northwest in 1924 and 1925. Several local growers also bought additional stocks for planting. Among the large growers starting about this time (in addition to George Lawler and George Ward Lawler) were: E. C. Orton, C. W. Orton, Frank Chervenka, L. M. Hatch, Otto Reise, H. F. Gronen, and Karl Koehler in the Puyallup Valley; Von Zonneveld of Washington at Chehalis; A. N. Kanouse at Olympia; E. B. Stookey at Olympia; Fred Delkin, Ira Edwards, and Case Van Lierop in King County; Marinus Lefeber, Frank Van Aalst, Harry Van Waveren, John Van Aalst, Floyd C. Kaylor, Garrett Van Zanten, and Segers Bros. in Whatcom County; and Mrs. Mary Stewart in Skagit County. United Bulb Company started at Woodland in 1929. There may also be others of whom the writer is not aware.

Because of the quarantine, the first expansion was naturally in daffodils, particularly in the variety Golden Spur.

However, more and more tulips and bulbous iris were being planted by the late 1920's. A census reports that in 1929 Washington led all other states in the production of daffodils, bulbous iris, and hardy lilies, but trailed Oregon in tulips. Washington's daffodil plantings increased to over 1000 acres, but on August 15, 1938, the daffodil quarantine was removed. Before the full impact of this could be felt, the second World War cut off most imports. The rise in Dutch bulb imports and a drop in prices since the end of the war have lowered returns to growers, while their cost of production has continued to increase.

McKay (31) reported that the wholesale price for DN King Alfred bulbs was about \$125 per 1000 in 1928. This contrasts with a 1956 price of \$52 for the largest size. Small wonder then that the total bulb acreage has dropped from its high of 2155 acres in 1948-49 to 1597 in 1955-56!

Puget Sound area dominates

Almost all of this acreage is in western Washington. Pierce County leads in production, followed by Skagit County. Most of the farms are rather large. For instance, four growers or companies (C. W. Orton, E. C. Orton, United Bulb Company, and the Tulip Grange) each had between 100 and 200 acres planted to bulbs in 1955. The yellow King Alfred and the blue Wedgwood comprise respectively about 85 per cent of the daffodil and iris acreage.

The Columbia River cut the bulb acreage one year. In 1948, it broke through dikes in Lewis County and flooded about 275 acres belonging to Tulips, Inc. and the United Bulb Company.

In 1922 Griffiths (22) stated that: "The bed system means hand labor; whether the bulb business in this country can be divorced from it remains to be

determined." The business and the bed system were divorced at a rather early age.

The Colyn brothers are believed to have made the first bulb digger, sometime in the late 1920's.

The type used today was perfected by Henry Edmondson, Howard Mansfield, Francis Chervenka, and others. The hopper type of mechanical planter apparently resulted from the ideas of several growers. Henry Reynolds made one of the first successful tulip planters.

In the early years of the industry, most of the bulbs were sold for early forcing in greenhouses, because they not only bloomed earlier than Dutch bulbs but usually produced better flowers. Recently, however, an increasingly large number of bulbs have been sold to department stores, seed stores, etc. In 1928 McKay reported that about 90 per cent of the narcissus bulbs marketed went to florists for forcing. Only 75 per cent of Washington bulbs were destined for florists in 1956. Many growers now sell cut flowers to supplement their reduced bulb income.

Some growers sell their bulbs direct to greenhouse forcers, jobbers and through retail trade channels. Other growers, mostly in Pierce County, banded together in 1926 to organize the Puget Sound Bulb Exchange for the selling and shipping of their bulbs. The Exchange has been one of the most successful cooperatives organized in Washington and now has about twenty-seven members who grow about one-third of the total bulb acreage.

Frank Chervenka was president the first year and C. W. Orton has been president ever since. Among others who belonged at the start were: E. C. Orton, Otto Reise, L. M. Hatch and H. M. Gronen. Gronen was manager for many years, followed by R. G. Fryar and recently, Th. Sabelis. In 1953 the Exchange shipped 60 carloads (about 20 million

bulbs) to various parts of the United States.

A Puyallup Valley Flower Co-op, Inc. was organized by about twenty growers in the winter of 1956-57. Francis Chervenka was elected president and Ben Korsten secretary. Chervenka was also designated manager pro tem. The purpose of the Co-op is to expedite merchandising of field-cut flowers through cooperative packing, selling and purchasing.

Recently several growers in the Mount Vernon, Washington area banded together to form the Skagit Valley Bulb Growers' Association. This is primarily a cooperative marketing undertaking. Ray Cowell is president and Harold Kenealy is secretary.

Several growers in Oregon formed the Bulb Co-op which has been in operation for many years, with offices in Portland.

Puyallup Valley Daffodil Festival attracts thousands

The annual Daffodil Festival fosters popular interest in and support of the bulb industry. This event began with an annual Steelhead Fish Banquet sponsored by the Sumner Chamber of Commerce.

As daffodil growing became more important, the use of flowers at the banquet became more common and the name of the event was changed to the Bulb Banquet. The first official one was sponsored in 1927 by the Sumner Chamber of Commerce.

Mr. and Mrs. C. W. Orton held an open house on April 6, 1926 for local mayors and others interested in seeing a collection of daffodil varieties. This open house was the forerunner of the "Bulb Sundays" in the early 1930's, (as sug-

Fig. 16. One of the floats in the Daffodil Festival parade that attracts throngs of spectators and publicizes the Northwest's bulb industry. (Photo courtesy of Lee Merrill, Tacoma.)



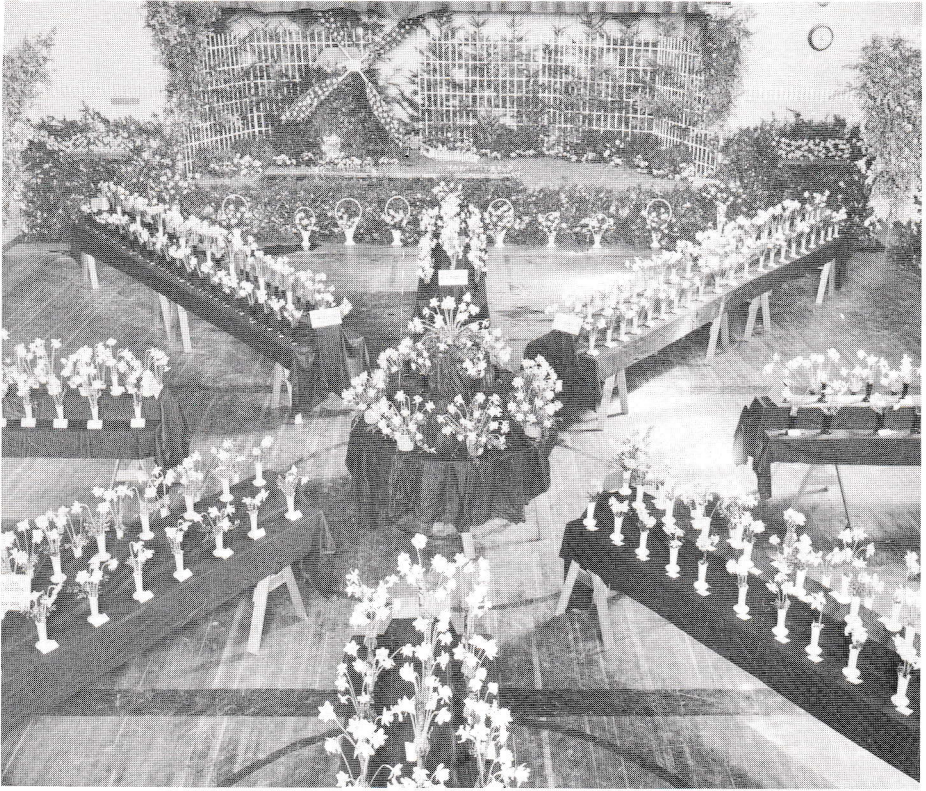


Fig. 17. The flower show part of the Daffodil Festival outgrew the Sumner High School gym and was moved to Tacoma. Above are variety collections at the show. (Photo courtesy Lee Merrill, Tacoma.)

gested by George Lawler) with visitors thronging the fields.

In 1934, the "Bulb Sundays" were changed to a two-day festival, featuring a parade that started in Tacoma, passed through Puyallup and Sumner, and ended in Orting. In 1937 twenty-five floats participated. By 1956, the parade was composed of fifty-nine floats, twenty-seven bands and many other units. More than two hours were required to pass the reviewing stand. Over 200,000 spectators in Tacoma and Puyallup Valley watched the parade. More than a million

blooms were used on these floats. One alone bore 250,000 daffodils (Fig. 16).

Flower shows, a brainchild of R. G. Fryar, began in 1931 in the Sumner High School gym. In 1949 they were moved to Tacoma where room was available for the exhibition of more varieties and arrangements (Fig. 17).

The Daffodil Festival has focused attention on the Northwest and the bulb industry through the widespread coverage of its colorful glamour in newspapers, magazines, on radio and TV. The festival committee and Bulb Association also

help promote bulbs at large stores throughout the United States. Robert E. Sconce has been publicity director for many years.

An annual tulip festival with a parade and floats of tulips was held years ago in Bellingham. Since 1946, an excellent tulip show has attracted thousands of visitors to LaConner each April.

Bulb growers' associations help the industry

In the spring of 1924 W. H. Paulhamus called a meeting of those interested in growing bulbs. This meeting resulted in organization of the Northwest Bulb Growers' Association. Amateurs were predominant at first, but gave way to commercial growers in the late 20's. George Ward Lawler was the first president and Joe Smith was the first secretary. Arthur Bowman was a key figure in the early days. W. T. Staatz of Sumner, Earle Darst, and R. L. Nowadnick of Mt. Vernon are now president, vice-president, and secretary, respectively.

The Association has very actively supported research, the daffodil festival, publicized Northwest bulbs, worked to reduce transportation charges, and tackled other projects. The association has prepared and distributed colored charts and streamers, reprinted and distributed recommendations for forcing Northwest bulbs, and keeps its members informed with the "Northwest Bulb Growers' Newsletter," edited by the Secretary.

To raise additional funds for advertising and other purposes, the growers started action in 1955. By 1956 the Washington Bulb Commission was formed. The first officers elected were: R. G. Fryar, Chairman; S. W. Staatz, vice Chairman, and Francis Chervenka, Secretary-Treasurer. Other members, representing various areas were: Miles Hatch, Sam Stewart, Wm. Roozen and Joe Berger.

This type of commodity commission had been authorized by the 1955 Washington State Legislature to raise funds to:

1. Establish and conduct a program for advertising.
2. Provide for research studies.
3. Improve standards and grades.
4. Investigate and take necessary action to prevent unfair trade practices (40).

The bulb growers were one of the first groups to petition for and organize such a commission. Assessment rates of 20¢ per 1000 narcissus bulbs and 15¢ per 1000 iris or tulip bulbs sold were adopted.

Research does much for bulbs

The research carried on by David Griffiths helped get the industry started in Washington. Other research has helped bulb growers keep going by increasing production and decreasing losses.

As mentioned earlier, a U.S.D.A. Bulb Station was established in Bellingham in 1908, primarily to study bulb culture.

In the late 20's T. H. Scheffer, also of the U.S.D.A. (stationed at Puyallup) was assigned to work on rodent control in bulb plantings in the West Coast. Through the efforts of Frank Chervenka and other local growers, the U.S.D.A. established an ornamentals insect research laboratory in 1928. C. F. Doucette*, Paul Eide, Ralph Schopp, F. J. Spruijt, Robert Nelson, C. H. Martin and Randall Latta in the Puyallup Valley worked on bulb insects. In 1933 the U.S.D.A. sent nematologist W. D. Courtney* to work on nematode problems. Another, W. J. Apt*, whose work is partially on bulbs, came in 1955.

State College of Washington scientists N. D. Locklin and G. A. Newton at the Western Washington Experiment Station began working in 1927 on the hot water

* Actively working on bulb problems at present.

treatment to control certain pests. Others, Todd Tremblay, C. J. Gould*, V. L. Miller*, E. P. Breakey, Arthur Myhre*, Glenn Huber and Karl Baur have continued since then on sprays, dips, and methods of handling bulbs for best flower performance.

Part of this research has been carried on in cooperation with the U.S.D.A. at Beltsville, Maryland. S. L. Emsweller*, Neil W. Stuart*, W. D. McClellan, Philip Brierley*, and Floyd Smith* work on bulbs at Beltsville.

College scientist Dwight Peabody* has carried on research at the Northwestern Washington Experiment Station at Mt. Vernon. E. W. Kalin and Neal A. MacLean worked on bulbs at the State College at Pullman, Washington.

Growers have also benefited from research in British Columbia by R. M. Adamson, H. Andison*, J. E. Boshier, J. H. Crossley*, R. J. Hastings, Wm. Newton and G. R. Webster. Oregon State College bulb work is done by F. P. McWhorter*, R. A. Young, H. J. Jensen*, M. G. Cropsey, O. C. Compton, Virgil H. Freed, Larry Blaney*, A. N. Roberts*, M. B. McKay, H. H. Millsap, and S. E. Wadsworth.

Glen Cushing of the Puget Sound Power and Light Experimental Laboratory at Puyallup developed various types of curing and other electrical equipment for the growers.

To help the growers in the Pacific Northwest keep up to date on recent developments, a Bulb Growers' Short Course was organized in 1948. The course is sponsored by the Western Washington Experiment Station and the Extension Service of the State College of Washington, The Northwest Bulb Growers' Association, and the State Department of Agriculture.

The course has been held annually ever since, with more than 100 growers, sci-

entists and inspectors participating. Information presented at the Tenth Short Course (March, 1957) has been compiled into an illustrated handbook on bulb growing and forcing and published by the Northwest Bulb Growers' Association.

Inspection fights disease and pests

Through its inspection work, the Washington State Department of Agriculture has helped growers keep bulb diseases, nematodes, and insects under control. The department has tried to prevent the importation of bulb pests from other areas. Ralph Marble and Henry Reynolds were inspectors in the early years. Roy Stillinger of the U.S.D.A. actively cooperated with them. George Eade is the present head of the Nursery Inspection Service.

Most domestic shipments of narcissus and iris are Washington-grown bulbs. The relative freedom from nematodes is indicated in a report from the U.S. Bureau of Entomology and Plant Quarantine. The bureau made a survey during 1948-49 to determine the distribution and degree of disease infestation on domestic-grown flower bulbs in interstate shipments. The Bureau's report stated: "The results of this domestic bulb survey tended to show the general absence, or only the presence of relatively small amounts of important pathogens such as the stem and bulb nematode (*Ditylenchus dipsaci* (Kuehn) Filipjev) in narcissus and *Ditylenchus* sp. in bulbous iris shipped interstate" (24).

Many varieties have been bred in the Northwest

Breeding new varieties has never become as popular in the Northwest as it has been in Holland, perhaps because the industry is so young. A few growers have been and still are working with narcissus, but none of the varieties is in

* *Ibid.*

large scale production yet. A. N. Kanouse, Jan de Graaff, Grant Mitsch, and Jac. Lefeber (who developed Flower Record in Holland) have been the most active in this field.

About thirty years ago, C. W. Orton did considerable hybridizing of bulbous iris. From his work have come several varieties of much merit. Pacific Gold, Yellow Prince, Moonlight and Snow-drift are a few that are in commercial production today and have shown considerable promise for forcing.

The popular Croft lily was named for Syd Croft of Bandon, Oregon. Croft was the first to propagate this lily commercially from a bulb that was reported to have been one of David Griffith's seedlings (33). Croft began marketing his lilies (including the Estate) about 1930. Although this lily never became big business with him, it certainly did with others in the Northwest, particularly after the onset of World War II.

The origin of the Ace lily is unknown, but it was first propagated commercially by Clark Slocum of Langlois, Oregon. New garden-type lilies of commercial importance have been hybridized or selected by David Griffiths, Jan de Graaf, LeVern Freimann, Edgar Kline, Alwyn Buckley, Frank Wilson and others in the Northwest.

Many new varieties of gladiolus have also come out of the Northwest. One of the most recent is Royal Stewart. This first All America gladiolus was introduced in 1955. Its "father" is Ralph Pommert of Pacific, Washington. Pommert has developed many other gladiolus varieties. He also organized the Washington Gladiolus Society in 1929.

Breeding work that should benefit Washington growers is being done on iris and Easter lilies by Dr. S. L. Emsweller at the Plant Industry Station, Beltsville, Maryland.

The Northwest's industry changes constantly

Various trends have been reported in the previous discussions. Among these are: an increase in bulb growing in the United Kingdom, Japan, and the Netherlands; decreased imports by the United States from the Netherlands but increased imports from Japan; a leveling off of iris, tulip, and daffodil bulb production, and an increase in mechanization in the Pacific Northwest. What is the net result for Washington State bulbous iris, tulip and narcissus growers?

When the bulb business was first established in the United States, one major outlet was sales to large estates. These sales often ran into thousands of bulbs per estate and price was no object. However, increasingly high taxes forced the sale and subdivision of large estates. To find other bulb markets, increasing emphasis was put on sales of bulbs for forcing.

Recently, both American and Holland dealers, reported a noticeable decrease in bulbs sold for greenhouse forcing and an increase in sales to the "dry trade." This change accompanies an overall shift in greenhouses from cut flowers to potted plants. The change is apparently stimulated by the development of the huge cut flower (primarily gladiolus and chrysanthemum) industry in Florida, California, and other warm regions of the United States.

This generalization is confirmed by data from a special study by Fossum (20). "Greenhouse cut flowers dropped from 58.7 per cent of total distribution in 1940 to 52 per cent in 1952, while over the same period greenhouse potted plants increased from 21.1 to 24.6 per cent of distribution."

How long the trend toward decreased production of flowers in greenhouses will continue is debatable. At least one key

man in this field believes that it will soon level off for bulbs. His belief is that flowers fit so well into a short-crop-small-space plan that greenhouse operators will not drop them completely.

In addition, the knowledge of forcing methods is increasing so that forcers can be better assured of success. To many people, bulb flowers are the most typical harbingers of spring and, therefore, will always be in demand to a certain extent. This same attitude is reflected in the limited demand for bulb flowers before Christmas.

The demand for bulb flowers may also increase as a result of the growing amount of research by scientists and trials by commercial growers on the use of packaged flowers for large scale outlets such as supermarkets. Fossum (20) reported that "from 1940 through 1945, growers' sales to department and variety stores and supermarkets amounted to 2.5% of the total, whereas, by 1952, the comparable amount was 5%." Because of their short growing period, bulb flowers may fit better than many other types of flowers into greenhouse production for such purposes.

Although sales for forcing are still the major income to bulb growers, there is a definite trend toward "dry" sales, bulbs sold through seed stores, department stores, mail order, etc. A good example is the Puget Sound Bulb Exchange; ten percent of their bulbs were used for dry sales in 1950. By 1956 their dry sales had climbed to 35 per cent (39).

Increased interest in home gardening because of extra leisure and the move to the suburbs, prosperity, and the spread of the "do it yourself" idea probably help account for the increased dry sales.

Several recent promotional programs have been built around bulbs, besides the chronic one of "free" bulbs for a soap wrapper, "plus a few cents for handling."

A two-week promotion by Sears & Roebuck in Seattle attracted considerable attention in 1955. Daffodils were sold by the pound—five pounds for 99¢. This amounted to 7¢ per bulb. Such programs, even if short, definitely help get people interested in bulbs—and also move large quantities of bulbs.

The dry sale trade (especially for packages) originally preferred small bulbs. Small bulbs were cheaper and cost less to ship. The heavy demand for such bulbs, accompanied by an intensified selection of best-producing stocks, has resulted in a natural selection of stocks producing mostly large bulbs. This has created another situation.

For instance, an average stock of daffodils now produces four or more DN1 (top size) daffodil bulbs for every DN2 produced. But the demand is often greatest for the smaller size bulbs. Hence, one major problem is to promote the sale of the largest daffodil bulbs. Daffodils are the major dry sale item, but sizable quantities of iris and even of tulips have been sold to this trade.

There is certainly ample opportunity for increased use of flowers in the United States. It has often been said that Europeans are more flower conscious than are Americans. Certainly, some bulb data support this viewpoint. The United Kingdom, with less than one-third the United States population grew 7,000 acres of tulips and narcissus and imported 224 million of these bulbs in 1955. The United States grew less than 3,000 acres and imported only 195 million of the same type. Even so, some bulbs produced in the United States had to be dumped because of surplus conditions.

In summary, the ornamental bulb industry in Washington State appears definitely to be in a stage of transition. Although the industry certainly is not strong, the decrease in acreage of tulips,

iris, and daffodils appears to have leveled off. Part of this equilibrium can be accounted for indirectly by rising prices of Dutch bulbs owing to increasing production costs in Holland. On the other hand, the rapid increase in Japanese production, together with their very low cost of production, pose an even more serious threat. Unless the Japanese prove unable to handle disease problems such as were partially responsible for the decline of the Gig Easter lily, they will export more.

On the brighter side of the domestic picture is the increase in dry sales of bulbs and the probability that the trend toward suburban living will increase the

demand even more for all ornamentals, including bulbs. Meanwhile, what are the possibilities for Washington growers? The following have been suggested by persons connected with the industry:

1. Marketing studies with an intensified advertising campaign based upon their findings;
2. Increased cooperative efforts among the growers;
3. More diversification of crops;
4. Concentration upon the fewest, most popular varieties;
5. More efficient mechanization;
6. Increased application of research discoveries.

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