The Commercial Greenhouse Handbook

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VAN NOSTRAND REINHOLD COMPANY
New York Cincinnati Toronto London Melbourne

Library of Congress Catalog Card Number 80-17324

ISBN 0-442-23146-6

Printed in the United States of America

Published by Van Nostrand Reinhold Company
A division of Litton Educational Publishing, Inc.
135 West 50th Street, New York, NY 10020, U.S.A.

Van Nostrand Reinhold Limited
1410 Birchmount Road
Scarborough, Ontario M1P 2E7, Canada

Van Nostrand Reinhold Australia Pty. Ltd.
17 Queen Street
Mitcham, Victoria 3132, Australia

Van Nostrand Reinhold Company Limited
Molly Millars Lane
Wokingham, Berkshire, England

16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1

Library of Congress Cataloging in Publication Data

Boodley, James William.
The commercial greenhouse handbook.

1. Greenhouse management. I. Title.
SB415.B66 635.9'823 80-17324
ISBN 0-442-23146-6

PREFACE

A two billion dollar industry, commercial plant production plays an important role in the dynamics of modern agribusiness. This growing industry has an increasing need for personnel trained in sound business practice and basic horticultural principles.

In this book, author James W. Boodley develops the basic outlines of the economics of the industry and presents the individual's role within this environment. Principles and practical applications of commercial plant and flower production are examined in the sections on Plant Growing Structures; Growing Media; Effects of Environmental Factors; Nutrition and Watering; Plant Propagation; Container Grown Crops; and Cut Flower Crops. The concluding section on Post Harvest Handling and Marketing of Pot Plants and Cut Flowers discusses the harvesting and storing of crops preparatory to marketing through wholesale and retail distribution channels.

In addition to chapter by chapter learning objectives, the book includes unit-end material that not only reinforces the information presented in the chapter but also serves as a departure point for further reader inquiry.

James W. Boodley, author of THE COMMERCIAL GREENHOUSE HANDBOOK, is Professor of Floriculture and Ornamental Horticulture at New York State College of Agriculture at Cornell University. Formerly on the staff of the Pennsylvania State University, he has served as the editor of the Pennsylvania Flower Growers Bulletin.

CONTENTS

CHAPTER 1
GEOGRAPHICAL LOCATION IN THE UNITED STATES

OBJECTIVES

After studying this unit, the student will be able to

- list the areas of major flower crop production in the United States.
- list the ten highest value florist crops.
- list the top six states in floriculture production.

THE FLORICULTURE BUSINESS

Growing flowers on a commercial basis is big business in the United States. From a small start around Philadelphia in the early 1800s, flower crop production (floriculture) now takes place in every state. According to the 1970 Horticultural Specialty Census, the wholesale value of the 22 leading flower crops sold in the United States was $439,000,000. This figure is just over 45 percent of the total sales of all horticultural specialties in 1970.

The top ten crops and the total sales value for each are given in Table 1-1.

The sales figures in Table 1-1 are those at the grower level. The retail value of floriculture is estimated to be three times as large. Thus, the total floriculture industry is worth more than $2,000,000,000 annually.

Much has happened to the industry since the Horticultural Specialty Census was taken. In 1970 the foliage plant boom was just beginning. Just five years later, in 1975, the value of foliage plant sales in 23 selected states was $187,183,000. For 1976, it was predicted that foliage plant sales would reach $230,000,000. Since then, sales have not declined but the extraordinary growth curve for foliage plants has flattened.

Table 1-1 Ten Top Florist Crops Sold*

Crop	Ranking	Total Sales
Chrysanthemum**	1	$119,630,995
Rose	2	60,800,568
Carnation	3	55,512,579
Cultivated foliage plants	4	50,817,378
Geranium	5	24,795,246
Gladiolus	6	20,918,107
Poinsettia	7	20,483,032
Azalea	8	19,544,640
Orchid	9	12,773,754
Lily	10	10,541,011

* 1970 U.S. Department of Commerce Horticultural Specialty Census

** Includes standards, pompons and pot mums

Today, foliage plants account for more than one-half of all potted plants sold in the United States.

PLANT PRODUCTION AREAS

Table 1-2 lists the six states leading in the sale of all horticultural specialties and the wholesale dollar value for each state.

Since 1970, the increase in the number of foliage plants grown in Florida has moved this state into the number one position ahead of California.

The early development of the greenhouse industry centered around the larger cities. One reason was the availability of manure that growers obtained from farmers on the outskirts of the cities. As the cities expanded and taxes increased, growers were forced to move to cheaper land.

The geographic location of flower production near urban centers is not as important as it once was. Jet aircraft now transport products quickly from one coast to another. The interstate highway system and the railroads have also reduced the time needed to move heavy, bulky items such as lily bulbs.

Weather has always been a factor in the location of a flower growing business. Certain types of climate make one area of the country more suited to growing one type of crop than another. For example, the need for high light intensity during the winter months resulted in the growth of the carnation industry in New England, along the middle Atlantic coastal region in the east, and in Colorado in the west.

The ability to control chrysanthemum flowering year-round led to the start of that industry in Florida. An ideal year-round climate and the availability of a large labor force led to the start of the industry in California.

The current energy crisis and expensive fuel are causing another movement of the floriculture industry from the cold northeast to the sunbelt region of southwestern United States.

Table 1-2 The six leading states in sales of all horticultural specialties*

State	Rank	Dollar Value
California	1	$203,681,761
Pennsylvania	2	102,374,938
Florida	3	87,903,567
Ohio	4	68,155,822
New York	5	44,097,709
Illinois	6	37,046,394

* 1970 U.S. Department of Commerce Horticultural Specialty Census

Pacific Northwest

Bulbs are produced in large quantities in northern California, Washington, and Oregon. The mild winters and the cool summers in this area produce the correct environment for lily, iris, and narcissus bulbs.

Lily bulbs are grown for Easter forcing. Wedgewood iris bulbs are also used for forcing. Growers on the Isle of Jersey off the English coast prefer American iris to those produced in Holland (despite the fact that transportation costs from Holland are much less expensive).

Many narcissus bulbs are sent to eastern growers to be forced in greenhouses. Other bulbs are brought to the bud stage and then shipped for cut flowers. Millions of narcissus are produced in the northwest for this purpose.

The climatic conditions that favor bulb growing and forcing in this area also benefit other crops. For example, azaleas from Oregon are grown until they can be shipped to other areas of the country for forcing directly into bloom or for growing on. The center of production for budded and grafted roses is in California, Washington, and Oregon. These plants are used by rose growers in the United States to produce cut flowers year-round.

This region also supplies Christmas holly and other cut greens used by retailers for flower arrangements.

Fig. 1-1 Seed production in California. Clouds are afternoon fog coming in from the sea. White square units are cheesecloth guards to prevent unwanted pollination by insects.

Fig. 1-2 Flowers being grown in California for seed.

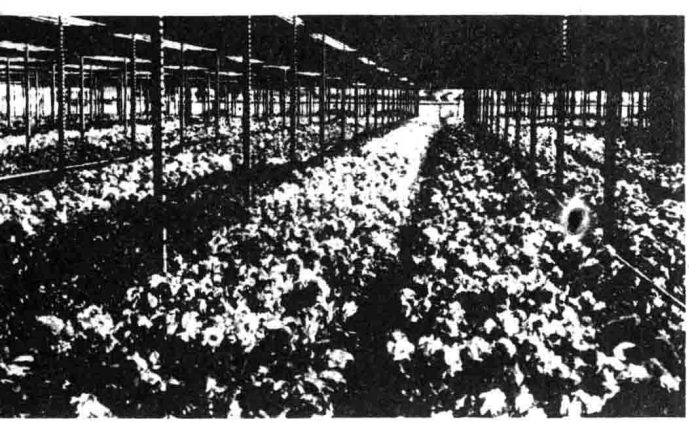

Fig. 1-3 Tuberous begonias growing under a slat roof shed in California.

California

California is the leading agricultural state in the United States. With a coastline extending a thousand miles from north to south, California provides nearly any climate needed to grow flower crops, figures 1-1 through 1-4. Chrysanthemums, carnations, and roses are produced in record numbers. These and other cut flowers are shipped to all parts of the country.

California has unique mountain ranges with valleys that open to the sea. The conditions in these valleys are ideal for the production of flower and vegetable seeds. Plant growth is stimulated by the cool nights caused by fog. The fog comes off the ocean in the late afternoon and disappears by mid-morning. Little or no rain at the time of seed harvest ensures a good crop. Widely known California seed producers include Bodgers Seeds, Ltd., W. Atlee Burpee Company, Goldsmith Seeds, and Pan-American Seeds.

Specialty propagators are attracted to the unique climate of California. Paul Ecke of Encinitas is the world's leading propagator of poinsettias. A number of companies have main offices in other sections of the country, but maintain propagation facilities in California. For example, Yoder Brothers is the primary supplier of chrysanthemum and carnation cuttings in the United States. The main office

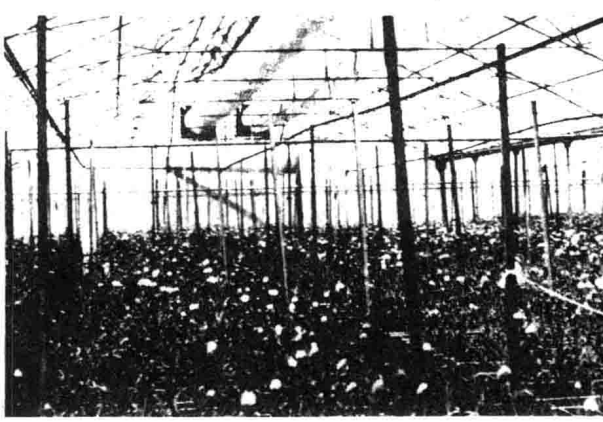

Fig. 1-4 Carnation production is big business in California.

and headquarters of this company are in Barberton, Ohio. George J. Ball, Pacific, headquartered in West Chicago, Illinois, is another large horticultural supplier. This company is known in horticultural circles throughout the world, figures 1-5, 1-6, and 1-7.

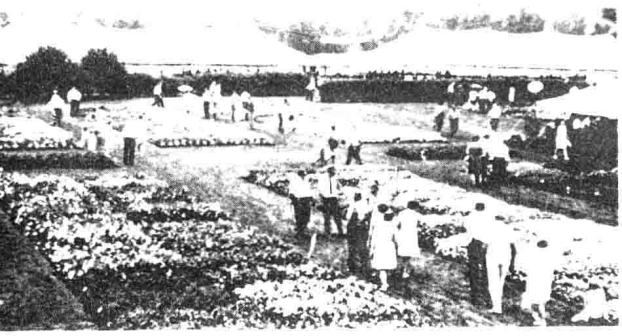

Fig. 1-5 Field Day at the George J. Ball, Inc. trial grounds in West Chicago, Illinois. Growers come from all over America to view the plantings.

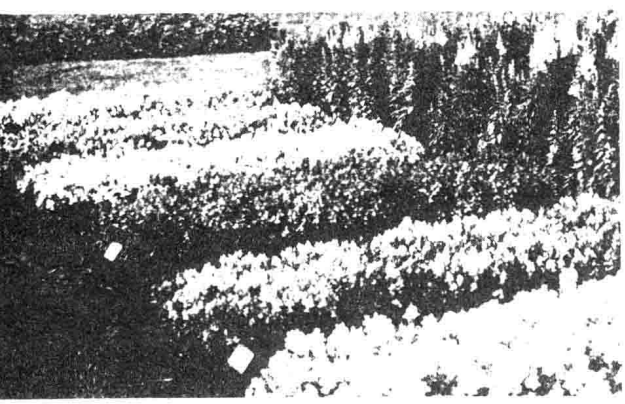

Fig. 1-6 Comparison plantings of garden snapdragons at the George J. Ball trial grounds in West Chicago, Illinois.

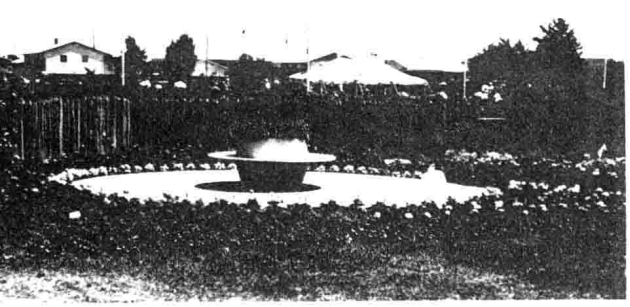

Fig. 1-7 This simulated backyard setting is used to show how bedding plants can be arranged and planted.

Hawaii

The floriculture industry in Hawaii is not very large when compared to that of some states on the mainland. According to the 1970 Horticultural Specialty Census, the dollar value was $5,663,323. Hawaii's two main export crops are anthuriums and orchids. Their export value is more than $3,500,000. Cut foliage shipped to the mainland accounts for a small part of the total sales figure. Plant production in Hawaii is shown in figures 1-8 through 1-13.

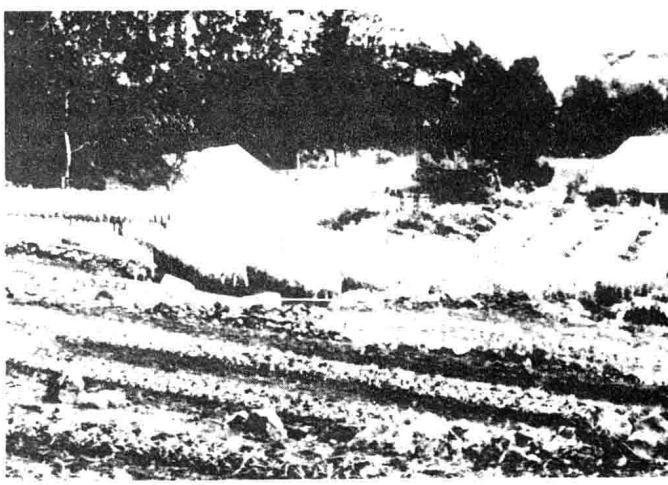

Fig. 1-8 Carnations grown on the island of Maui are used locally for making leis.

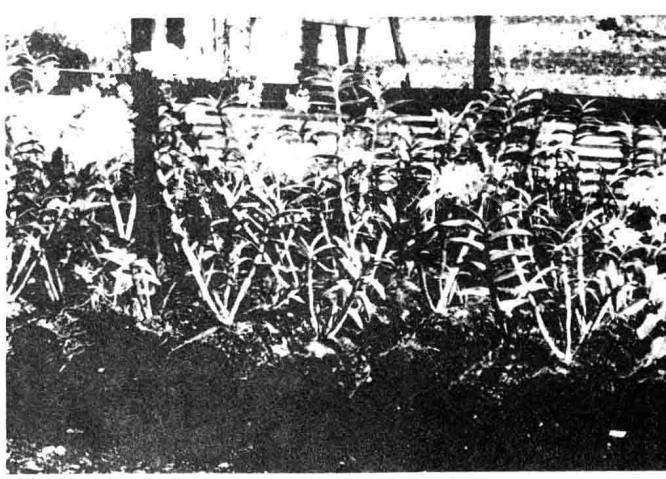

Fig. 1-9 Orchids, shown growing on Hapuu fern logs in Oahu, are one of the leading export flowers from Hawaii to the U.S. mainland.

Fig. 1-10 The pseudobulbs of these Vanda orchids are tied to pieces of Hapuu fern logs placed on the ground.

Fig. 1-11 The flowers of these Vanda orchids are exported to the mainland. Notice that the Hapuu fern has also started to grow.

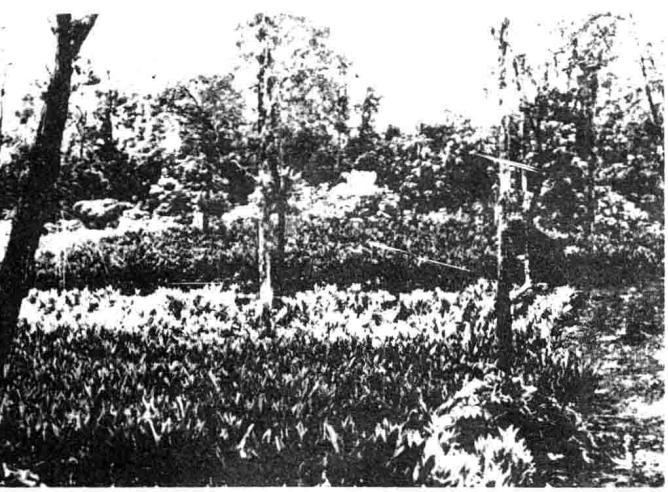

Fig. 1-12 Newly cleared land planted to Cordyline terminalis. The cut foliage is exported to the mainland states.

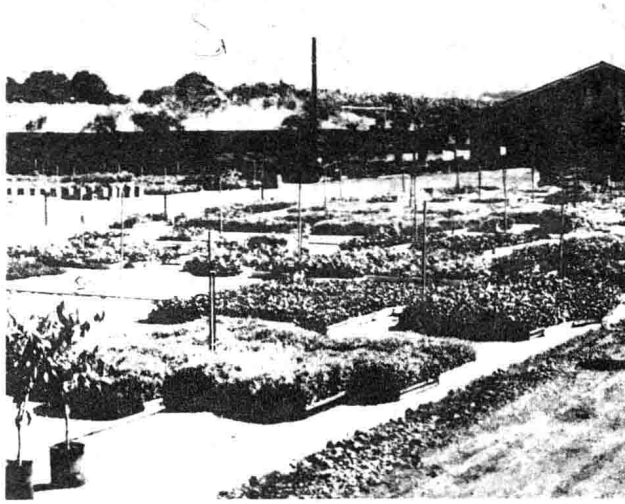

Fig. 1-13 The plants shown at this foliage plant nursery in Hawaii are used locally.

Colorado

For many years, Denver, Colorado was called the "Carnation Capital of the World." That title may no longer apply, but the high light intensity during the winter still makes it an ideal area for growing carnations. Some growers have shifted to foliage crops. In addition, roses are being produced in greater numbers in this area.

Texas

Tyler, Texas is called the rose capital of that state. Acres of field grown roses are produced in Tyler for sale to home owners as garden plants. Texas also produces some commercial stock. Growers in Texas are beginning to increase their production of foliage plants. Because of the shift of plant production from the northern states to the

sunbelt. Texas may soon rank third in the United States as an ornamental plant production area.

Florida

Florida leads other states in the production of tropical foliage plants and gladiolus. Chrysanthemums are also grown in quantity outdoors under shade cloth, figures 1-14, 1-15, and 1-16.

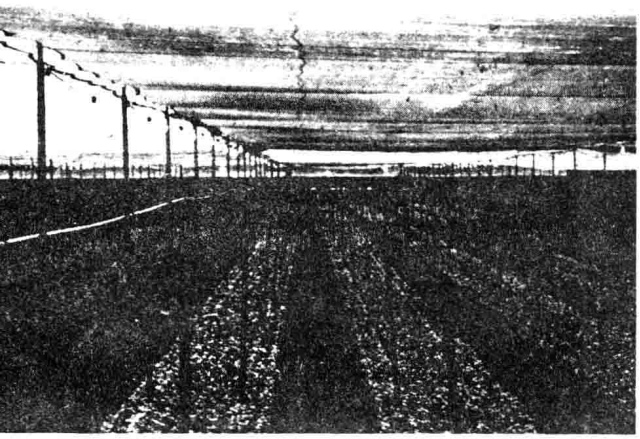

Fig. 1-14 Chrysanthemums grown under saran cloth with lights to prevent the plants from flowering.

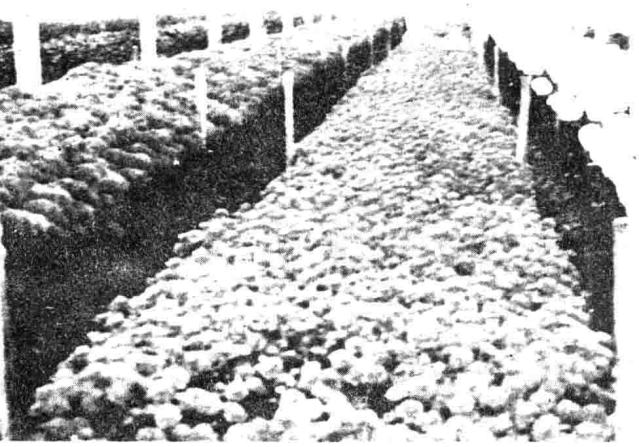

Fig. 1-15 Pompon or spray-type chrysanthemums in bloom in Florida.

Miami is a port of entry for flowers shipped from Puerto Rico and Central and South America.

Other Areas of the United States

Throughout the rest of the country, a large number of different crops are grown in glass- and plastic-covered greenhouses. During frost-free periods, a few special crops are grown outdoors.

Peonies are a major outdoor crop in parts of Illinois. However, they are less important now as a wholesale crop. Near Bloomsburg, Pennsylvania, several acres of chrysanthemums and asters are grown outdoors in the summer in cloth houses.

Changes will continue to take place in the floriculture industry as the costs of production increase, without an equal increase in the return to growers. Cheaper production in countries outside the United States has already forced major production changes in areas of this country. Foreign competition is discussed in Chapter 2.

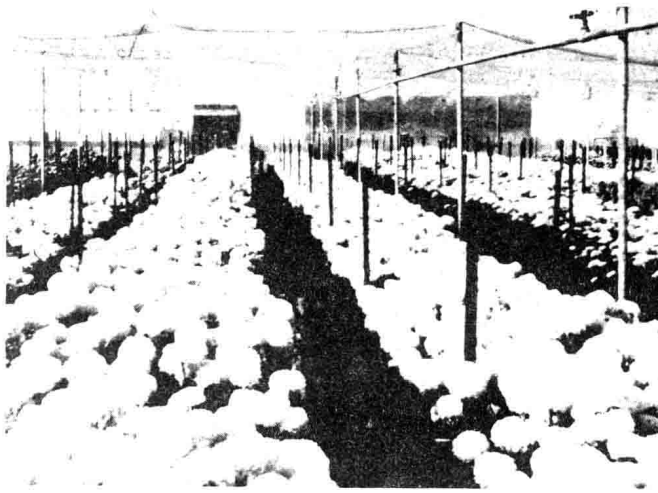

Fig. 1-16 Standard chrysanthemums ready for harvest.

ACHIEVEMENT REVIEW

Select the best answer or answers to complete each statement and list the appropriate letter(s).

1. The value of the 22 leading flower crops sold in 1970 according to the Horticultural Specialty Census was
   a. $250,000,000.
   b. $338,000,000.
   c. $439,000,000.
   d. $643,000,000.

2. Place the following crops in the order of sales, first to fourth, as reported in the 1970 census.
   a. carnations
   b. cultivated foliage
   c. chysanthemums
   d. roses

3. As compared to the reported value in the 1970 horticultural census, tropical foliage plant sales for 1976
   a. stayed the same.
   b. increased by doubling.
   c. were three times greater.
   d. were more than four times greater.

4. Place the following four states in order of their importance, first to last, in the production of flower crops in the United States.
   a. California
   b. Florida
   c. Ohio
   d. Pennsylvania

5. The chrysanthemum industry started in Florida as a result of
   a. the invention of plastic shade cloth.
   b. the ability to control flowering year-round.
   c. a migration of northern growers to Florida.
   d. the development of grades and standards.

6. The geographical area where bulb crops are grown is
   a. the middle Atlantic states.
   b. southeastern United States.
   c. southwestern United States.
   d. the Pacific northwest.

7. Fog coming from the ocean to the coastal valleys of California at night provides an ideal climate for growing
   a. crops for seed.
   b. cut stock.
   c. outdoor roses.
   d. gladiolus.

8. The two main flower crops exported from Hawaii are
   a. anthuriums.
   b. cut foliage.
   c. green plants.
   d. orchids.

9. For years Denver, Colorado has been called the _____ capital of America.
   a. carnation
   b. chrysanthemum
   c. foliage plant
   d. rose

10. Florida is first in the production of
    a. chrysanthemums.
    b. foliage plants.
    c. poinsettias.
    d. roses.

CHAPTER 2
FOREIGN COMPETITION WITH UNITED STATES FLOWER CROPS

OBJECTIVES

After studying this unit, the student will be able to

- list the major cut flower crops imported into the United States.
- list the countries with the largest number of flower exports to the United States.
- explain the importance of imports and exports to the floriculture industry.

Flower and ornamental crops imported into the United States are valued at millions of dollars. Both the quantity and the dollar value of these imports increase each year. Although the United States has been importing these crops for many years, it was not until 1970 that complete records were kept on imports.

TYPES OF FLOWERS IMPORTED AND DOLLAR VALUE

The dollar values of cut flower imports for selected years are shown in Table 2-1. These data show the large yearly increase in the dollar value of the imported crops. Between 1972 and 1977, there has been a similar increase in the number of flowers imported.

Table 2-2 shows the major exporting countries and the number of stems shipped for the major cut flower crops and for *Chamaedorea* (palm) fronds. These data are listed by type of crop in decreasing order of total imports.

Table 2-1 Value of cut flower imports[1]

Period	Dollars[2]
1971	2,738,000
1972	4,030,000
1973	11,657,000
1974	19,764,000
1975	19,812,000
1976	25,356,000
1977	38,310,000

[1] Adapted from FATUS, *Foreign Agricultural Trade of the United States,* various issues to January, 1978.

[2] Value of imports is expressed as the market value in the foreign country. This value does not include duties, freight, or insurance.

For example, the major exported item is *Chamaedorea,* followed by carnations, and so on. Note that Colombia, South America leads the list as the largest exporter of carnations, chrysanthemums (both standard and pompon types), roses, daisies, and statice.

Table 2-2 United States imports of cut stems from 1972 to 1977

Item and Country	1977	1976	1975	1974	1973	1972
CHAMAEDOREA	431,564,000	431,308,000	365,587,000	361,473,000	352,218,000	366,038,000
Guatemala	127,837,000	115,401,000	103,259,000	81,610,000	102,526,000	131,546,000
Mexico	302,114,000	315,208,000	259,229,000	279,027,000	248,441,000	230,802,000
CARNATIONS (total)	284,583,000	204,451,000	162,268,000	179,969,000	129,490,000	56,153,000
Colombia	276,496,000	193,069,000	151,097,000	163,638,000	116,558,000	47,828,000
Costa Rica	—	—	—	—	1,271,000	1,011,000
Ecuador	110,000	66,000	4,023,000	7,755,000	4,594,000	3,867,000
Guatemala	942,000	775,000	366,000	1,714,000	—	—
Mexico	5,016,000	6,644,000	6,001,000	5,907,000	3,748,000	2,491,000
CHRYSANTHEMUMS	18,996,000	12,589,000	17,384,000	25,892,000	23,231,000	15,8[illegible]000
Colombia	15,596,000	9,641,000	12,233,000	13,767,000	9,584,000	4,945,000
Costa Rica	—	1,000	127,000	267,000	651,000	983,000
Ecuador	45,000	74,000	1,064,000	1,791,000	1,762,000	1,197,000
Guatemala	2,601,000	2,371,000	3,375,000	7,456,000	9,137,000	6,716,000
Mexico	606,000	333,000	332,000	514,000	—	—
Netherlands	113,000	148,000	—	—	455,000	294,000
POMPONS	140,638,000	114,762,000	75,793,000	64,348,000	43,468,000	25,241,000
Colombia	130,921,000	104,978,000	70,158,000	52,053,000	24,681,000	13,181,000
Costa Rica	1,323,000	634,000	321,000	1,356,000	2,509,000	2,612,000
Ecuador	846,000	881,000	1,801,000	1,791,000	1,762,000	1,197,000
Guatemala	7,503,000	8,187,000	3,262,000	8,965,000	14,114,000	8,035,000
DAISIES	12,679,000	10,119,000	14,464,000	19,378,000	10,225,000	3,395,000
Colombia	5,787,000	4,697,000	7,707,000	13,463,000	6,887,000	1,617,000
Guatemala	3,123,000	2,451,000	3,591,000	3,055,000	2,567,000	1,623,000
Mexico	6,582,000	2,696,000	2,859,000	2,427,000	535,000	81,000
ROSES	10,346,000	6,245,000	4,192,000	3,551,000	3,396,000	1,676,000
Brazil	—	—	—	—	398,000	114,000
Colombia	7,711,000	4,513,000	2,554,000	810,000	—	—
Costa Rica	55,000	4,000	214,000	575,000	656,000	336,000
Guatemala	147,000	120,000	180,000	407,000	289,000	372,000
Israel	838,000	274,000	269,000	405,000	—	—
Netherlands	1,277,000	1,057,000	816,000	1,254,000	1,073,000	648,000
STATICE	7,683,000	2,381,000	4,691,000	5,870,000	4,837,000	2,542,000
Colombia	5,297,000	750,000	326,000	—	—	—
Ecuador	37,000	164,000	1,079,000	882,000	—	—
Guatemala	1,034,000	154,000	1,062,000	3,013,000	1,381,000	1,097,000
Mexico	1,291,000	1,307,000	2,201,000	1,176,000	731,000	959,000
TULIPS	1,836,000	1,867,000	1,966,000	1,885,000	2,347,000	1,856,000
Netherlands	1,827,000	1,700,000	1,940,000	1,824,000	2,310,000	1,854,000
ORCHIDS	1,014,000	575,000	775,000	1,106,000	1,037,000	1,038,000
Australia	635,000	433,000	618,000	931,000	929,000	967,000
New Zealand	176,000	91,000	131,000	140,000	76,000	63,000

Source: United States Department of Agriculture. Agricultural Marketing Service, 630 Sansome Street, Room 727, San Francisco, CA 94111. Adopted from San Francisco Ornamental Crops Reports, December, 1972, 1973, 1974, 1975, 1976, and 1977.

MAJOR EXPORTERS OF FLOWER CROPS

Several natural and national advantages led to the development of the floriculture industry in Central and South America. The continuing effect of these advantages should lead to a further increase in the industry in these areas.

Tropical America experiences a wide variation in climatic conditions. Such conditions favor the growth of many different crops in a natural setting.

Colombia

Bogotá, the capitol city of Colombia, South America, is a major source of flower crops. The elevation of Bogotá is nearly 8,600 feet. At this altitude, the nights are cool and the days are comfortably warm. Generally, the weather conditions are ideal for growing a number of different flower crops.

In addition to the favorable conditions, the cost of labor in Colombia is much lower than the cost to American growers. The daily wages of the Colombian worker range from $1.50 to $4.00 for eight hours of work. Ten years ago, workers received from $.90 to $1.50 for a day's work. Many of the larger growers provide extra benefits for their employees, such as medical care, breakfast at a greatly reduced price, and paid vacations. Despite these benefits, the wages are so low that American growers cannot compete in labor costs.

Because the work is not complicated and the wages are so low, Colombian growers can hire more workers than American growers normally employ. In general, the greater number of workers means that the planting, maintenance, and harvesting of the crops will require less time.

The climate around Bogotá is ideal for growing carnations, figure 2-1. Although there are frosts in the winter, no heat is required in the greenhouses where the carnations are grown, figure 2-2. There are over fifty farms around Bogotá producing carnations. Some of these farms were started by Americans who recognized the advantages of this area for flower production. Many of the cut flowers are used in Colombia. Others are grown for export.

Marguerite daisies are grown in open fields near Bogotá, figure 2-3. The daisies are harvested in the field and are dyed pink, yellow, blue, green, and other colors. Then they are shipped to markets in the United States and Europe.

Chrysanthemums and roses are also grown on farms around Bogotá, figure 2-4. These crops need a minimum night temperature of 60°F (15.5°C). As a result, the greenhouses where these crops are grown must be heated. The greenhouses consist of a wooden framework covered with polyethylene sheeting.

Fig. 2-1 Bogotan worker grades Colombian-grown carnations for shipment to the United States and other countries.

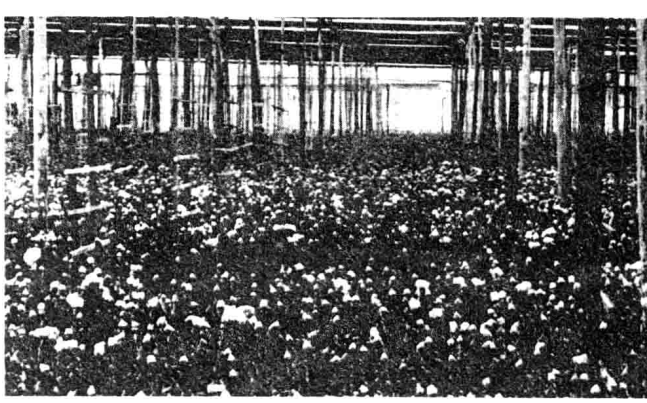

Fig. 2-2 Carnations being grown in a greenhouse in Bogotá, Colombia, South America.

These structures must be recovered every year because the high light intensity breaks down the plastic.

Medellin (pronounced Med-a-yeen) is a large city about one hour west of Bogotá by airplane. Just over the mountain range from the city is a valley where the night temperatures seldom go below 60°F (15.5°C). Chrysanthemums are grown here under plastic-covered structures. Artificial heat is not required. The plastic protects the plants from the heavy rainfall during the rainy season. In addition, the plastic protects the crop from a number of potentially serious diseases.

Despite the low labor costs and the favorable climate, crop growers in Colombia do have a number of problems. Most supplies are brought into the region by air. The cost of air freight is very high. The import duties on a large item often increase the cost to five times that of the original price. Delays in shipment are common due to flight cancellations.

The cut flower crops are also exported by air. Cut flowers are perishable and can be damaged easily. Part or all of a shipment can be lost by overheating while waiting to be loaded on the plane, or by freezing in the storage compartment of the plane during the flight.

Other American Countries as Exporters

Other areas in tropical America produce a variety of crops in addition to cut flowers. For example, exotic orchids are flown from Brazil and various Central American countries to North American markets.

One of the oldest floriculture firms is located in Cartago, Costa Rica. One of the outstanding plant breeders in the world is Mr. Claude Hope of Costa Rica. His farm has produced some of the best hybrid petunia seeds ever developed. Guatemala produces flower seeds that are sold worldwide.

Guatemala also produces over one million cut fronds (leaves) of the *Chamaedorea* palm. These fronds are used in florists' arrangements. *Chamaedorea* fronds are also exported by Mexico; more than three million fronds were sold to the United States in 1977.

Other Exporters of Floriculture Crops

Countries around the world ship flowers and plant materials to the United States. More than one million orchids arrive each year from Australia and New Zealand. Both Israel and the Netherlands exported over two million cut roses to the United States in 1977. The Netherlands also shipped 1.8 million cut tulip flowers

Fig. 2-3 Marguerite daisies growing in an open field in Colombia. The plants are harvested and bunched in the field.

Fig. 2-4 Chrysanthemums in Bogotá showing the shading effect of the gutter of the roof.