# Industry & Trade Summary

## Seeds

USITC Publication 2859
May 1995

OFFICE OF INDUSTRIES
U.S. International Trade Commission
Washington, DC 20436

UNITED STATES INTERNATIONAL TRADE COMMISSION

## COMMISSIONERS

**Peter S. Watson, Chairman**
**Janet A. Nuzum, Vice Chairman**
**David B. Rohr**
**Don E. Newquist**
**Carol T. Crawford**
**Lynn M. Bragg**

---

Robert A. Rogowsky
Director of Operations

---

Vern Simpson
Director of Industries

---

*This report was prepared principally by*

John Pierre-Benoist

Agricultural Crops Branch
Agriculture and Forest Products Division

**Address all communications to**
**Secretary to the Commission**
**United States International Trade Commission**
**Washington, DC 20436**

# Preface

In 1991 the United States International Trade Commission initiated its current *Industry and Trade Summary* series of informational reports on the thousands of products imported into and exported from the United States. Each summary addresses a different commodity/industry area and contains information on product uses, U.S. and foreign producers, and customs treatment. Also included is an analysis of the basic factors affecting trends in consumption, production, and trade of the commodity, as well as those bearing on the competitiveness of U.S. industries in domestic and foreign markets.[1]

This report on seeds covers the period 1989 through 1993 and represents one of approximately 250 to 300 individual reports to be produced in this series during the first half of the 1990's. Listed below are the individual summary reports published to date on the agricultural, animal, and vegetable products sector.

| *USITC publication number* | *Publication date* | *Title* |
|---|---|---|
| 2459 | November 1991 | Live Sheep and Meat of Sheep |
| 2462 | November 1991 | Cigarettes |
| 2477 | January 1992 | Dairy Produce |
| 2478 | January 1992 | Oilseeds |
| 2511 | March 1992 | Live Swine and Fresh, Chilled, or Frozen Pork |
| 2520 | June 1992 | Poultry |
| 2544 | August 1992 | Fresh or Frozen Fish |
| 2545 | November 1992 | Natural Sweeteners |
| 2551 | November 1992 | Newsprint |
| 2612 | March 1993 | Wood pulp and waste paper |
| 2615 | March 1993 | Citrus Fruit |
| 2625 | April 1993 | Live Cattle and Fresh, Chilled or Frozen Beef and Veal |
| 2631 | May 1993 | Animal and Vegetable Fats and Oils |
| 2635 | May 1993 | Cocoa, Chocolate, and Confectionery |
| 2636 | May 1993 | Olives |
| 2639 | June 1993 | Wine and Certain Fermented Beverages |
| 2693 | November 1993 | Printing and Writing Paper |
| 2726 | January 1994 | Furskins |
| 2737 | March 1994 | Cut Flowers |
| 2749 | March 1994 | Paper Boxes and Bags |
| 2762 | April 1994 | Coffee and Tea |
| 2865 | April 1995 | Malt Beverages |
| 2859 | May 1995 | Seeds |

[1] The information and analysis provided in this report are for the purpose of this report only. Nothing in this report should be construed to indicate how the Commission would find in an investigation conducted under statutory authority covering the same or similar subject matter.

# CONTENTS

# CONTENTS—*Continued*

# CONTENTS—*Continued*

# INTRODUCTION

This summary report provides information on most commonly known seeds for sowing.[1] Included are seeds, fruits, and spores[2] of a kind used for sowing. The primary groups of these are beet seeds and forage plant seeds— alfalfa, clover, fescue, Kentucky blue grass, rye grass, timothy grass, and miscellaneous grass seeds. Also included are seeds of herbaceous plants cultivated primarily for their flowers (flower seeds), vegetable seeds, tree seeds, grain (cereal) seeds, and mushroom spawn.[3] Also included are products classified as seed in the *Harmonized Tariff Schedule of the United States* (*HTS*) although seeds such as edible celery seed are often used for purposes other than sowing. Whenever possible, this summary discusses seed groups in accordance with *HTS* headings. Mushroom spawn is provided for in chapter 6 of the *HTS*. The remainder of the seeds are provided for in chapters 7, 10, and 12 of the *HTS*. Seeds that are excluded from this summary include the oilseeds, such as soybean, flax seed, and grain and legume seeds for which there are no separate HTS provisions for seeds for sowing.

The world seed market is valued at about $45 billion. The seed industry estimates that 40 percent of the world's approximately 1,500 seed companies are located in the United States. The largest seed company in the world is a U.S.-based multinational, Pioneer Hi-bred[4] with activities in over 40 countries, and worldwide annual seed sales in the neighborhood of $1.3 billion[5]. In 1993 the United States exported close to $580 million of seeds, and had a positive seed trade balance of over $374 million. Corn seed is the most significant U.S. seed exported. In 1993, the United States exported close to $168 million worth of corn seed, accounting for 29 percent of all U.S. seed exports.[6] Although U.S. seed production data are no longer published, approximately 15,000 farms produced seeds on about 476,000 hectares in 1982.[7]

Information in this report discusses the structure of the U.S. and foreign seed industries, domestic and foreign tariff and nontariff measures, and the competitive conditions in domestic and foreign seed markets. The analysis generally covers the period 1989-93.

The seed industry is broadly composed of three sectors: production, marketing, and research and development (R&D). Seed producers include four groups: "non-commercial" seed farmers and producers who hold back a portion of the current crop as seed for the next crop; farmers who propagate and multiply seeds for sale[8]; farmers who propagate and multiply seeds under contract for large seed-marketing or development firms; and seed-marketing or development firms that themselves directly propagate and multiply seeds on their research stations.

The second sector, the marketing sector, is composed of farms and firms that market seeds. Seeds are marketed by farmers as well as by firms that range in size from local, family-run firms to multinational distributors such as Pioneer Hi-bred.

The third sector is seed R&D firms that concentrate on improving current seed varietals in order to produce plant varieties with more of the desirable traits. Seed R&D activities draw together botanical, bio-engineering, horticultural, and other disciplines. R&D activities range from traditional manual pollination in greenhouses to high-cost biotechnological[9] processes—such as recombinant DNA and genetic engineering—that must take place in the laboratory. In the United States, seed research is undertaken by the U.S. Department of Agriculture and the land-grant universities, as well as by private seed marketing-development firms.

The United States is a major world producer, with about 500,000 hectares devoted to seed production.[10]

---

[1] The seeds covered in this summary are those which are specially provided for in the *Harmonized Tariff Schedule of the United States* (*HTS*).

[2] A spore is defined as a germ, germ cell, seed, or the like; a germ is defined as a bud, offshoot or seed. In seed plants, the spore is the first cell of the gametophyte generation. The micro spore and the mega spore produce male and female gametes (or seed cells), respectively.

[3] Spawn is defined as the mycelium of mushrooms, especially of the species grown for the market (mycelium is the vegetative part of the fungi). Spawn is a common term applied to a mixture of fungal mycelium and nutritive organic material for the artificial propagation of mushrooms.

[4] The mention of a corporation or product is in no way meant to imply endorsement by the U.S. Government.

[5] Rabobank, Utrecht, Netherlands.

[6] Compiled from official statistics of the U.S. Department of Commerce.

[7] U.S. Department of Commerce, *Census of Agriculture* (1982), the last year for which data are available.

[8] Multiplication of protected varieties is controlled under the provisions of the laws controlling intellectual property rights (IPR), as discussed below.

[9] For a discussion of biotechnology, please refer to U.S. International Trade Commission (USITC), Office of Industries, USITC Staff Research Study 17, *An Overview of Commercial Biotechnology in the United States* (Nov. 1991). Biotechnology is defined as a rapidly growing, research-intensive, multidisciplinary range of technologies that uses living organisms for a variety of pharmaceutical, agricultural, and chemical purposes. Biotechnology includes any technique that uses living organisms or develops microorganisms for specific uses.

[10] The U.S. Department of Agriculture no longer publishes seed production statistics. *Data from the U.S. Department of Commerce publication, Census of Agriculture (1982)*, however, indicate that U.S. seeds are grown on about 500,000 hectares, about 100,000 hectares of which are irrigated.

Domestic seed producers are known worldwide for their ability to multiply seeds, and for producing proprietary varieties (seeds that have been selected through breeding or other methods for special characteristics). Seeds from many countries are sent to the United States for multiplication. The greater part of domestic consumption is provided by domestic production.

Barriers to world seed trade include duties, phytosanitary regulations and nontariff barriers to protect private industries worldwide. The lack of adaptability of seeds in one country to the soil and climate conditions of another is another barrier limiting seed trade.

It may take 10 to 20 years to develop and market a new seed. A cooperative relationship between public and private research institutions, and private seed development corporations, is important. A strongly supportive banking-investment sector is also necessary. The development of a certain seed encompasses proprietary knowledge. Seed development, production, and marketing are fostered by an environment that protects intellectual property rights (IPR). This summary includes a discussion of national and international intellectual property laws designed to protect proprietary seed products.

## PRODUCTION PROCESSES

Seeds constitute one of several means by which plants reproduce. A seed is defined as a dormant form of plant life, that is the fertilized, mature ovule of a flowering plant, containing an embryo or rudimentary plant. Thus, a seed is part of the sexual reproduction of a plant. Plants may also be reproduced asexually through grafts, corms[11], or tubers, as in the case of the potato. To produce, a seed must first be planted in a growing medium, such as soil, so that a plant will grow from which seeds may be harvested. Asexual modes of plant and seed reproduction are not described by this summary.

The Federal Seed Act of 1939[12] defines a plant variety as a "subdivision of a kind which is characterized by growth, plant, fruit, seed, or other characters by which it can be differentiated from other sorts of the same kind." A plant "variety" incorporates genetically inheritable traits or characteristics such as size, color, taste, degree of pest and disease resistance, and adaptability to such climatic conditions as resistance to drought, and other problems. Plant varieties may result from processes such as initially cross-pollinating or "mating" varieties to incorporate the desired traits into a hybrid or offspring of two different varieties into a new variety. A "varietal hybrid" seed is the product resulting from the mating of two varieties. "Seed development" refers to the process of establishing and improving seed varietal hybrids.

The formation of seeds in higher plants depends on processes of sexual reproduction in the flower. Plant flowers exist to produce seed. The six principal steps in the development of reproductive plant structures leading to the formation of seeds are—

1. Formation of stamens containing pollen, which later form male sperm cells, and formation of the pistil—the "female" part of the flower reproduction organ, containing the ovary;
2. Opening of the flower to signal the sexual maturity of the plant reproductive organs;
3. Pollination, which transfers the pollen from the stamen to the pistil;
4. Pollen germination and formation of the pollen tube;
5. Fertilization of the egg and polar nuclei; and
6. Maturation of the seed.

The various methods of producing improved varieties include manually cross-pollinating plants to insure the exchange of genetic material that would not otherwise occur. Other methods entail the use of various biotechnological methods (recombinant DNA) to combine hereditary traits between various plant tissues, cloning these tissues and then producing seeds from the new varieties of plants.

## SUMMARY SEED CATEGORIES

### Mushroom Spawn

Mushroom spawn is used to propagate mushrooms. It consists of dormant mycelium[13] in a medium that will sustain it. The medium in which mushroom mycelium is planted is usually a grain such as rye, sorghum, or millet. Mushrooms are grown in dark, moist environments. Spawn is sold to mushroom producers by the quart, usually in bottles.[14]

[11] A corm is the fleshy, bulb-like base of a plant such as the crocus.

[12] Federal Seed Act (Aug. 9, 1939, c. 15, § 1, 53 Stat. 1275), 7 U.S.C. § 1551 to § 1611.

[13] The underground portion of the mushroom fungus.

[14] Five-year data on exports, imports, trade balance, and unit values are listed in appendix A, starting with table A-1 on mushroom spawn.

## Dried Leguminous Vegetables

Dried leguminous vegetables are consumed primarily as edible vegetables. Dry peas, beans, and lentils[15] are annual legume crops.[16] The edible seeds of these pod-bearing plants are also called pulses. There are hundreds of varieties of dry peas, beans, and lentils marketed around the world. The legume crops grown from the seeds for vegetable production are not only important protein sources, but they make excellent soil conditioners. Legume crops take nitrogen from the air and add it to the soil, thus increasing soil fertility for the following crop, especially in a crop rotation program. Nonlegumes do not *add* nitrogen to the soil that it previously did not contain, they merely take nitrogen from the soil, replacing only partially what was taken.[17]

## Cereal Grains

In terms of volume, acreage, and economic value, cereal grains are among the most important crops in the United States, with large amounts of seed used to produce these crops. Corn (maize), wheat, oats, and grain sorghum seeds for sowing are separately provided for in chapter 10 of the HTS, and are included in this summary. Seeds of other cereal grains (for example, barley, rye, and rice) are not separately provided for in the HTS and are not included in this summary.

Although the value of the seeds produced for cereal crops may not be large, the value of the crops grown from these seeds has major importance. Corn and wheat are major U.S. crops, and major components of U.S. agricultural exports. Many varieties are available to farmers, who may choose a certain seed based on such factors as yield, milling characteristics, pest and disease resistance, and adaptability to a certain region.

Wheat and oats are self-pollinating. A farmer typically purchases highly developed seeds of a new wheat or oats variety and then produces his own seeds for an extended period of time. Thus, the wheat or oats farmer does not depend on the seed companies. On the other hand, the wind pollinates corn and grain sorghum. Further, virtually all corn and grain sorghum is grown from hybrid seeds that do not breed true.[18] Therefore, corn and sorghum farmers depend entirely on being able to purchase certified seeds each year, although wheat and oats farmers need to purchase certified hybrid seeds only periodically.[19]

## Beet Seed

Sugar and table beets are biennial[20] plants. Sugar beet seed is normally produced by the winter annual method: the seed is planted in August-September, overwintered[21] in the field, and harvested in July. The seed is separated from the stalk through a milling operation.

Unlike most of the other kinds of seeds, sugar beet seed usually does not enter ordinary marketing channels. Sugar beet seeds generally are produced by, or for, companies producing beet sugar. These companies provide the seed to growers who produce sugar beets on a contract basis.[22]

## Seeds of Forage Plants

The forage plant[23] seeds included in this summary are alfalfa, clover, birdsfoot trefoil, fescue, Kentucky blue grass, rye grass, timothy, and other grasses (such as bent grass, Bermuda grass, bromegrass, orchard grass, Sudan grass, and wheatgrass).[24]

### *Alfalfa Seed*

Alfalfa seed is used in the production of one of the most widely grown cultivated forage legumes, alfalfa (*Medicago sativa*).[25] Alfalfa is a perennial crop of which the soil-improving ability is used in crop

---

[15] For further information on dry peas and lentils, please refer to USITC, *Dry Peas and Lentils: Conditions of Competition between the United States and Canada in Third-Country Markets* (investigation No. 332-335) USITC publication 2167, Apr. 1993.

[16] A legume plant bears pods, as do beans, peas, and cowpeas. This large family is called the legume family, or the *Leguminosae*. Legumes are economically important because of their feeding value; they tend to have a higher protein feeding value than nonlegumes (not only in the seeds, but also in the leaves and stems). Legumes also contain a comparatively large quantity of vitamins A and D, and calcium and phosphorus.

[17] Trade and unit value data for sweet corn, peas, beans, lentils, and other dried leguminous vegetable seeds for sowing are shown in tables A-2 to A-11.

[18] Not breeding true means that the seeds produced from the hybrids are not of the same variety, but rather will tend to revert to the varieties from which the hybrid was developed.

[19] Trade and unit value data for cereal grain seeds for sowing are found in tables A-12 to A-15.

[20] A biennial plant normally requires two growing seasons to produce seed.

[21] The term *overwintered* means that, since it takes 2 years for the plant to yield seeds, it must be left in the field during the winter.

[22] Trade and unit value data for beet seed are found in tables A-16 and A-17.

[23] Forage is feed from plants for livestock, such as hay, pasturage, straw, and silage.

[24] Trade and unit value data for the seeds of forage plants are found in tables A-18 to A-24.

[25] For more complete information on the U.S. and Canadian alfalfa industries, please refer to USITC, *Alfalfa Products: Conditions of Competition Between the U.S. and Canadian Industries* (investigation No.332-310), USITC publication 2472, Dec. 1991.

rotation. Alfalfa is grown throughout the United States and is used extensively in domestic markets as forage for livestock and as an ingredient in compound feed manufacture.[26]

## *Clover Seed*

Varieties of clover are grown in virtually all parts of the United States. Clovers are the largest class of forage plants.

Although occasionally confused because of their names, red clover (*trifolium pretense*) and crimson clover (*trifolium incarnatum*) are two quite different species of clover, as the following tabulation shows:

| | Crimson clover | Red clover |
|---|---|---|
| Growing period | Annual | Perennial |
| Growing area | Oregon California, Idaho | Oregon, Washington |
| Use | Plowdown | Forage/ pasture |

Alsike clover seed is used in the production of a perennial seed and forage legume grown in the Midwest and the Pacific Northwest. The plant is well adapted to cool climates and wet soils. It tolerates soils higher in acidity or alkalinity than most other clovers. Alsike clover is often grown in mixtures with other grasses or legumes as a hay or pasture crop.

Most sweet clover seed is used in growing biennial legumes, but some annual forms are also grown. Although these legumes are important soil-improving crops, they are also used for pasture and hay. These clovers are hardy and drought resistant, growing well under a wide range of soil and climatic conditions.

White clover (*trifolium repens*) seed is used in growing a perennial legume. Ladino clover is a type of white clover similar to common white, but two to four times as large. Various forms of white clover are used throughout the world for pasture, cover crops, and lawns. When grown in mixtures with grasses and other legumes, they are often used as hay or silage[27] crops.

Other notable types of clover are alyce, beseem, hop, Persian, strawberry, and subterranean. These are classified in a residual ("other") statistical subheading. Alyce clover, a summer annual variety, is grown for hay and soil improvement. Hop, Persian, and beseem clovers are winter annual varieties grown for pasture, hay, and silage. Strawberry clover, a long-lived perennial, and subterranean clover, an annual, are used primarily for pasture.

[26] Trade and unit value data for alfalfa seed are found in table A-18.

[27] Silage is fodder preserved in a silo.

## *Fescue Seed*

Fescue grass is any grass of the genus *festuca*. It includes both fine-leaved and coarse-leaved species. The principal fine-leaved species, Chewings and creeping red, are perennial grasses that withstand considerable wear and tear and are found in most lawn mixtures. Tall fescue, the principal coarse-leaved species, is a hardy grass used for pasture and lawn grass.

## *Blue Grass Seed*

Blue grass (*poa pratensis*) is a fine-leaved pasture and lawn grass adapted to temperate and cooler climates with moderate rainfall. The most popular of the domestically grown species is Kentucky blue grass, a long-lived perennial spread by rhizomes.[28] Kentucky blue grass is used extensively, both alone and in mixtures with other seeds, for lawn and turf applications. Kentucky blue grass is also used for pasture. Most Kentucky blue grass seed produced commercially in the United States is used for seeding lawns. Merion, an improved variety, is a Kentucky blue grass seed of note. Merion seed production is quite specialized. Merion grass is grown in rows—rather than broadcast—and is harvested by combines. Seed produced in this manner is generally of a particularly high quality in terms of germination and purity.

Other varieties of blue grass seeds are Canada, annual, bulbous, mutton, roughstalk, Sandberg, Texas, and wood blue grass. These blue grass varieties are generally used in pastures and lawns where soil and climatic conditions are not suitable for Kentucky blue grass. Roughstalk blue grass is used as a lawn or pasture grass in moist, shady areas.

## *Rye Grass Seed*

Rye grasses (*colium multiflorum lam., colium perennial*) are of two primary types: common and perennial. Common rye grass is an annual that provides a relatively low-cost green manure or cover crop and is used for forage and soil-conservation purposes. Perennial rye grass seed is used primarily in permanent pasture grass mixtures. Owing to its relatively rapid growth, it is used to furnish forage for livestock while slower growing grasses become established. In establishing lawns, perennial rye grass seed is used in mixtures with common rye grass and other lawn grasses.

## *Timothy Seed*

Timothy seed produces a short-lived perennial grass. This grass is adapted to a cool humid climate, and the seed is generally used in mixtures with alfalfa or clover for planting hay or pasture crops.

[28] A rhizome is a creeping stem below the surface of the soil.

*Miscellaneous Grass Seeds*

Bent grasses, except redtop, are fine-leaved grasses used primarily as lawn grass. Some of the bent grasses are used on the greens on golf courses. Bent grasses are usually perennial, although there are some annuals, and may be propagated from stolons[29] or from seeds. Although it is used in nearly every section of the United States, bent grass is best adapted to the cool moist climate found in the Northern States.

Redtop is a coarse-leaved bent grass. It is planted in mixtures with other pasture grasses and in grass legume mixtures for pasture or hay. It is used in lawn seed mixtures, but is not considered a permanent lawn grass. Land used for redtop seed production in the past has often been diverted to more profitable crops, such as soybeans and corn.

Hybrids constitute an important part of the seed industry. One example is Sorghum-Sudan grass *(sorghum biocolor X sorghum sudanense)* that has been nicknamed by farmers "hay grazer." It is one of many forage hybrids, and it is produced mostly in Texas. Its production entails the use of *sorghum biocolor* as a sterile parent, and the use of sudan grass (listed under *HTS* heading 1209.29.00.60) as a pollinator. About 400 square meters ($m^2$) are grown over the winter in Puerto Rico to establish the seed. Virtually all export sorghum-sudan grass is sold as certified seed, whereas certification is not a requirement in the domestic market.

Bermuda grass (*cynodon dactylon*) is used on lawns, golf courses, for highway beautification, and for pasture. The market for Bermuda grass has been declining; production fell from an estimated 6,000-7,000 metric tons (mt) in 1989, to approximately 3,175 mt in 1991.[30] The industry attributes the decline to poor margins and prices. Only about 450 mt of production is certified because the market has not paid an adequate premium for certification.

Orchard grass seed is used in growing a tall, perennial, bunch type of grass. This grass is tolerant of shade and is therefore well adapted for use in orchards and other shaded areas. It is less winter-hardy than most of the major grasses. Orchard grass is usually grown in mixtures with other grasses or legumes. Most orchard grass is used in States north and east of Arkansas, owing to its ability to produce vegetative growth before other spring grasses and legumes. Over the last several years, demand for orchard grass to be used for improving pastures has increased in the South.

[29] A stolon is a creeping stem above the soil surface from which roots form.

[30] The latest available figure for Bermuda grass production is for 1991.

Sesbania seed is used in growing an annual subtropical legume. It is occasionally used as a green-manure crop or as a cover crop in orchards in the Southern States.

There is little demand for tall oat grass in the United States. Tall oat grass is a perennial which is well adapted to a cool moist climate. A major use of tall oat grass is in mixtures with seeds of legumes and other grasses as a pasture and green manure crop.

Some 30 species of wheatgrass are native to North America. The most important are western, bluebunch, and slender wheatgrass. The most important species introduced into the United States are crested, tall, and intermediate wheatgrass[31]. All of the important wheatgrasses are hardy, cool season, and drought resistant perennials.

## Flower Seeds

Perhaps as many as 1,500 different varieties of some 100 different species of flower seed are grown commercially in the United States. About two-thirds of flower seed production occurs in a dozen popular varieties such as marigolds, pansies, petunias, and zinnias. Flower seed production is highly specialized. Hybridization of many species is resulting in continuous improvement in plant quality.[32] Production of flower seed is best suited to areas having a mild climate with little rain during the growing and harvesting seasons, and where irrigation is available.

## Vegetable Seeds

Vegetable seeds are used in commercial vegetable production as well as in home gardens. Some vegetable seeds are used as condiments or in bird food. Although the classification of vegetable seeds does not depend on the end use, vegetable seeds must meet quality standards under the Federal Seed Act.[33]

A number of seeds are demanded for human consumption. The most notable are celery and pumpkin seeds.

The value of seeds used for seeding is dependent on the genetic characteristics of these seeds, such as the size, color, resistance to pests or disease, or the number of days until the vegetable is ready to harvest. The unit value of vegetable seeds can range from less than $2.20 per kilogram (kg), to several hundreds or even thousands of dollars per kg for seeds of certain hybrids of vegetables such as peppers, tomatoes, and broccoli.

[31] This term should not to be confused with *wheat*, the cereal grain.

[32] Trade and unit value data for seeds of herbaceous plants grown principally for flowers are shown in table A-25.

[33] Trade and unit value data for vegetable seeds are shown in table A-26.

Vegetable seed growers often grow flowers, both for seed and for the flowers. However, most growers of vegetables and flowers do not also propagate seeds.

### Tobacco Seeds for Sowing

Tobacco seeds are very small round seeds generally planted in greenhouses or protected tobacco sheds and raised to seedlings. The seedlings are then transplanted in the field and raised to full-size tobacco plants. Three main types of tobacco seeds are produced domestically: flue-cured, burley, and Maryland.

Tobacco seed is quite small. Only about 28 grams of tobacco seed are required to plant approximately 3 hectares, yielding a tobacco crop worth several thousand dollars. Naturally, then, the market value of the tobacco seed is relatively high, around $110 per kg.

### Tree, Shrub, and Other Seeds

These seeds are covered under *HTS* subheadings 1209.99.20.00 through 1209.99.40.80. Tree and shrub seeds include seeds of forest trees, fruit trees, ornamental trees, and shrubs. Forest and fruit tree seeds are most commonly produced in the United States. Government agencies and private landowners use forest tree seeds for reforestation and conservation. Fruit tree seeds are primarily used by commercial nurseries for growing rootstocks.[34] The residual ("other") category includes miscellaneous seeds *other* than vegetable seeds, grass seed, forage crop seeds, or flower seeds.[35]

Tree seeds are collected in forest areas in nearly every State by forest products firms (primarily lumber and paper companies) and by State/Federal forestry service agencies. Recent years have seen an increase in farms for tree seeds, which select and collect seeds from vigorous trees that have the characteristics desired by nurserymen. Shrub seed markets are limited because most shrubs are propagated by softwood cuttings, grafting, and root division. Consequently, shrub seed and other seed producers are few and are estimated at about 2,000.

## U.S. INDUSTRY PROFILE

### Industry Structure

The Standard Industrial Classification (SIC) categories applicable to the industry are as follows:

| Industrial No. | Nomenclature |
|---|---|
| 0111 | Wheat |
| 0115 | Corn |
| 0119 | Cash grains — not elsewhere classified |
| 0132 | Tobacco |
| 0139 | Field crops, except cash grains |
| 0181 | Ornamental floriculture and nursery products |
| 0182 | Food crops grown under cover |

Figure 1 shows the interrelationships among the seed industry sectors and subsectors involved in the development, production, marketing, and use of seeds. The public sector often provides basic research to develop new and improved seed varietals. In the United States, the public sector includes the land-grant universities that work closely with the U.S. Department of Agriculture. The seed varietals are then shared with traditional private-sector seed-development and biotechnology firms that further develop them into "parent seeds," that is seeds that can be reproduced for commercial use.

An example of a government contribution to basic and applied long-term seed-related research is the U.S. Vegetable Laboratory in Charleston, SC, founded in 1936. This laboratory has developed many varieties of vegetables, including the Charleston Hot Pepper, the Charleston Crag Watermelon, and the Homestead Tomato. Scientists at this laboratory propagate vegetables by crossing strains and then growing offspring. Seed products such as these are sought primarily by seed-producing companies that want to develop their own hybrids. Research is of prime interest to the large seed companies.

Traditional seed development firms, or breeders, utilize techniques such as manual cross-pollination of plants to develop new or improved seeds. Biotechnology firms use more advanced technologies, such as recombinant DNA. Owing to the very high costs associated with seed development involving biotechnology techniques, firms using this modern approach concentrate on those seeds that will provide higher returns, such as those for large field crops such as wheat and corn. Firms developing vegetable and flower seeds tend to be smaller and more traditional.

Firms that develop seeds rely on the U.S. Plant Variety Protection Act for patent protection of their investment. The provisions of the International Union for the Protection of New Varieties of Plants (UPOV) provide additional means by which seed firms secure the intellectual property inherent in new seeds.[36]

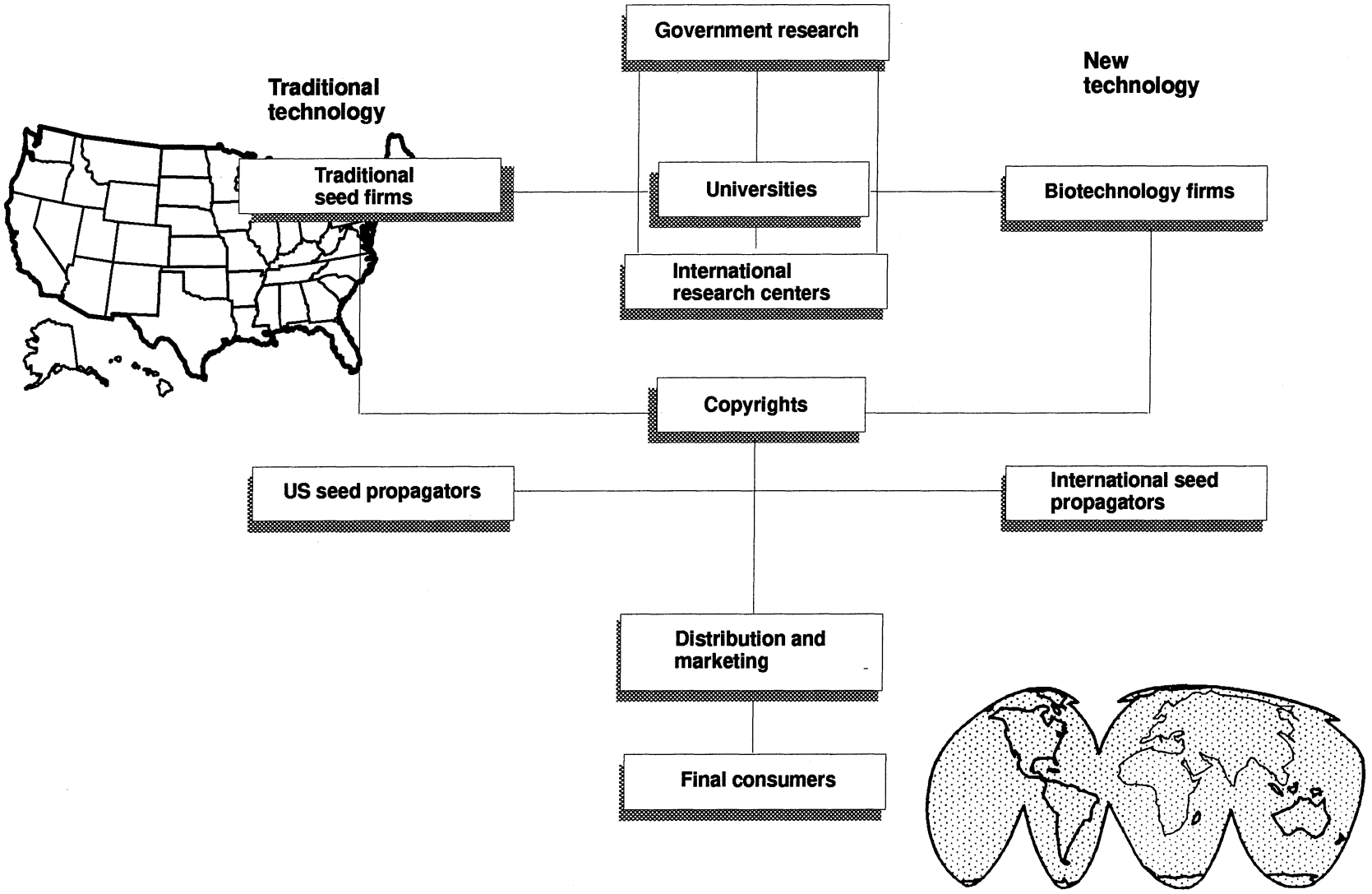
Once a "parent" seed is patented, seed propagators or producers, multiply the seed into quantities sufficient to sell at the wholesale and retail levels.

[34] Rootstock is a root and its associated growth buds used as a stock in plant propagation.

[35] Trade and unit value data for seeds in *HTS* subheading 1209.99 are shown in table A-27.

[36] Both the PVPA and the UPOV are discussed below.

**Figure 1**
**Seed development flowchart**




Source: USITC Staff.

Seed propagators may be farmers who produce under contract, or they may be marketing/development firms that produce the seed on their research stations. Seed production also includes seed sorting, seed classification for purity, and packaging. Seed producers may apply for their seed to be certified by appropriate state agencies. They attest that a certain seed consignment is certified for cleanliness, genetic purity, and for a minimal germination rate. Not all seeds are certified.

Figure 2 shows the different production and marketing channels for seeds. Seed propagators include four groups of producers: seed development firms that produce newly patented varietals; "noncommercial" farmers or producers that hold back a portion of the current crop as seed for the next crop; commercial farmers or producers that produce seed for sale; and farmers who produce seed on contract for seed development firms. Such production is channeled into own-use, local use, and to seed marketing firms and brokers. Seeds may be marketed to exporters directly or through seed brokers.

The seeds, once marketed, either nationally or internationally, may be used on commercial operations for the production of cereal, vegetable, fruit, or horticultural crops. They may be used by gardeners for the production of home gardens; or they may be used by food or pharmaceutical industries. In addition, some seeds are also marketed as food for birds, for example, black oil sunflower seeds. Others are marketed to snack food, perfume, and spice industries.

### *Employment, number of firms, concentration*

The USDA no longer publishes data on employment for the seed industry. The number of farms and the number of acres devoted to growing seeds is used instead as a proxy for seed industry employment. Between 1978 and 1982 (the year of the last available *Census of Agriculture*),[37] the number of farms producing seeds decreased by nearly 24 percent, from almost 20,000 to just over 15,000 (table 1). There was a concomitant decrease in area harvested for seeds of nearly 15 percent, from 559,000 to 476,000 hectares. The average size of a seed-producing farm was 32 hectares overall in 1982, however, irrigated operations were substantially larger, averaging 50 hectares in 1982.

Concentration levels in the industry vary depending on the sector (production, marketing, or R&D) and on the kinds of seeds produced. Since some 15,000 farms are involved in seed production-propogation, and no one farm is dominant, this sector is not regarded as concentrated.

The American Seed Trade Association (ASTA) lists approximately 150 U.S. companies that are involved in one or more of the production, marketing, and R&D sectors of the seed industry. There are also many other small companies that specialize in only one or a very few types of seeds, as well as other companies that are multinational non-U.S. firms operating in the United States. In the past, seed-marketing firms have tended to be small, specialized family operations. However, after the 1970's advent of adaptable high-yielding varieties for the global market, there have been more and more corporate acquisitions and mergers. Today about six firms account for more than three-quarters of the U.S. development and marketing of flower seeds, and some 20 firms account for 90 percent of the development and marketing of vegetable seeds. Seeds for the production of large-scale cash crops, such as corn or wheat, tend to be products of the larger multinational firms. Firms comprising the R&D subsectors of the industry tend to be large and multinational. This part of the industry is considered to be quite concentrated.[38]

The modern complex of seed-related industries is far more inclusive than the traditional seed company. Biotechnical companies, seed breeders, farmers, seed merchants, and others participate in this dynamic industry. The seed industry buying guide lists over 500 breeders, exporters, growers, importers, wholesalers, retailers, and brokers,[39] (with most firms serving more than one function), dealing in over 60 categories of seeds.[40]

Since the late 1970s, the seed industry has undergone a wave of acquisitions. Prior to then, acquisitions were driven by the need for diversification, while the latest movement has been motivated by new cell and molecular biologies. Multinational corporations with biotechnology operations are moving to assume seed industry leadership in production, marketing, distribution, and other vital industry sectors, by paying premium prices for viable seed companies.

Although U.S. companies dominate the list of seed enterprises, these firms are globally-oriented, rather than solely national enterprises. The larger seed corporations are multinational firms with various affiliates, subsidiaries, or joint-ventures. For example, Pioneer, a large U.S. corporation and the largest seed firm in the world, has subsidiaries in over 40 countries

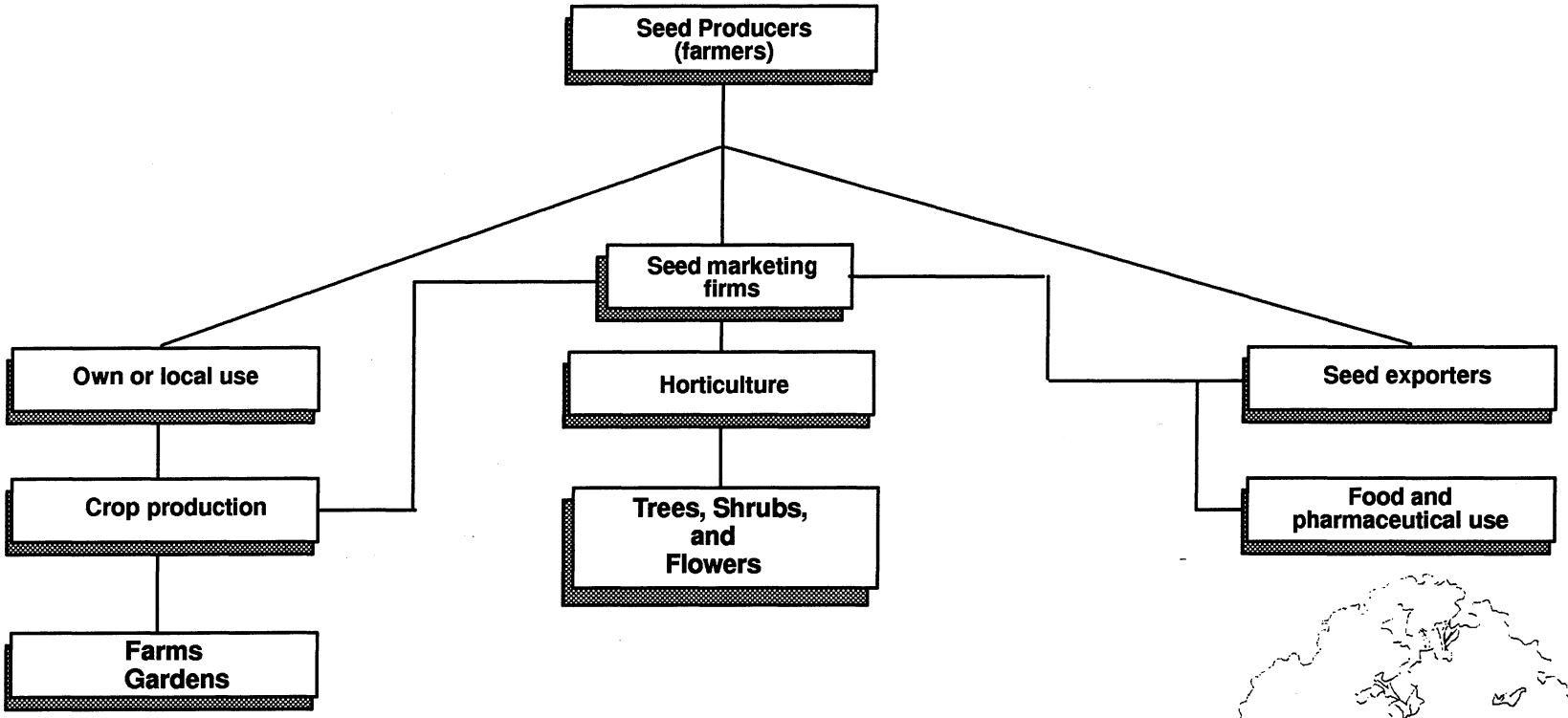
[37] *Census of Agriculture, op. cit.*

[38] Especially when biotechnology R&D is involved.

[39] A broker markets seeds nationally and internationally for the seed producers or seed firms.

[40] *Seed World, 1992 Seed Trade Buyers Guide.*

**Figure 2**
**Seeds: Principal marketing channels for U.S. crops**




Source: USITC Staff.

**Table 1**
**U.S. field seed and grass seed crops: Number of farms and acreage produced, 1978 and 1982**

| United States | 1978 | 1982 | Percent change |
|---|---|---|---|
| Harvested: | | | |
| Farms (number) | 19,703 | 15,039 | -23.67 |
| Hectares | 559,190 | 475,626 | -14.94 |
| Irrigated: | | | |
| Farms (number) | 2,693 | 2,060 | -23.51 |
| Hectares | 125,822 | 103,307 | -17.89 |

Source: U.S. Department of Commerce, *Census of Agriculture* (1982).

throughout the Americas, Africa, Europe, Oceania (Australia, New Zealand, and various islands), and Asia. The ten largest seed corporations in the world are: Pioneer (United States, $1.3 billion in 1992 worldwide seed sales), Sandoz (Switzerland, $625 million), Groupe Limagrain (France, $440 million), Takii (Japan, $360 million), Upjohn (United States, $300 million), Sakata (Japan, $300 million), Cargill (United States, $275 million), Amylum (Belgium, $275 million), Cebeco (Netherlands, $260 million), and ICI (U.K., $250 million).[41]

Of the world's 1500 seed companies, 600 can be found in the U.S. and 400 in Europe (concentrated in France and the Netherlands). Concentration within the seed industry is increasing; the 25 largest companies produce almost half of all commercial seed.[42]

## *Geographic distribution*

As outlined below, seeds are grown in virtually every part of the United States.

*Mushroom spawn.* Domestic production of mushroom spawn is centered around Kennett Square, Pennsylvania, where there are about 10 producers. Other producers are located in Ohio, Michigan, California, and Texas.

*Vegetable seeds.* Although vegetable seeds are grown in many States, most are produced in the western states because of favorable climate and the availability of land. Seed purity requires crop segregation. Dry air and lack of rain during summer and fall—when many of the seed crops mature—facilitate harvesting and threshing. The largest variety of vegetable seeds is produced in California where widely ranging climatic conditions within a relatively short distance enables seedsmen to supervise diverse crops from a central location. Vegetable seeds are produced in the following U.S. regions:

*Pacific Northwest:* cabbage seeds, garden beets, spinach.

*Western States* (interior regions): beans, peas, sweet corn, melons, squash, carrots, onions, lettuce, turnips, radish, and other dry-seeded crops.

*North Central and Eastern States:* tomatoes, sweet corn.

*Southeast and South:* pimento pepper, eggplant, watermelon, okra, edible cowpeas.

*South Central and Southeastern States:* Austrian winter peas.

Localized production of specific types of vegetables also occurs in other areas. For example, the Puget Sound area of the State of Washington has concentrated on seed production for biennial members of the cabbage family (such as cabbage, cauliflower, kale, and Brussels sprouts). Several kinds of vegetable seeds are produced in Idaho (including sweet corn, lettuce, radishes, endives, carrots, spinach, and onion). Many of the vine crop seeds (for example, watermelons, cantaloupes, and cucumbers) are produced in Oregon and Colorado.

*Legume seeds.* Perennial legumes include, among others, alfalfa, various clovers, various trefoils, various lespedezas, and crown vetch.

The primary source of alfalfa seed is the Great Plains, the Intermountain areas, and the West where irrigation is available (particularly in Washington, Oregon, and the Central Valley of California).

Although substantial amounts of clover seeds are harvested from hayfields and pastures in the East, certified seed production occurs largely in the West. Oregon and Idaho produce alsike clover seed. White clover seed is produced largely in Wisconsin, Alabama, Mississippi, Louisiana, Idaho, and Oregon. The center of Ladino clover seed production is in California. Crimson clover seed is produced largely in Oregon, as well as in South Carolina, Georgia, Tennessee, Alabama, Mississippi, and Arkansas.

Lupine seed production is largely confined to the Southeastern States, owing to favorable temperatures. Vetch[43] seed is grown primarily in Arkansas, Oklahoma, Texas, California, Idaho, Oregon, and Washington.

[41] "World Seed Market Faces Stagnation," *Agra Europe*, Aug. 26, 1994; data are from the *World Seed Market*, published by Rabobank, Utrecht, Netherlands.
[42] Ibid.
[43] Vetch are any of several mostly climbing, leguminous herbs used for forage and soil improvement.

*Grass seeds.* Two broad groups of grasses are based on their season of growth: cool-season and warm-season grasses. Most of the perennials have good winter hardiness and flourish in the northern half of the United States. These include the fescues, wheatgrasses, blue grasses, bromegrasses, orchard grass, timothy, rye grass, bent grasses, and redtop.

Production of noncertified seed of orchard grass has been centered in Kentucky, Virginia, and Missouri. Most of the certified seeds—especially of improved varieties—are produced in the West.

The western part of the Corn Belt is a primary source of both noncertified and certified bromegrass seed. Timothy seed is produced from pastures and meadows in the Corn Belt. Most redtop seed is harvested in Illinois and Missouri.

Missouri has been the largest producer of tall fescue, followed by Kentucky, Arkansas, and Kansas. Oregon accounts for most of the creeping red fescue and Chewings fescue seed produced in the United States. Seed production in the Pacific Northwest tends to be highly specialized, such that production of seed such as fescue may provide the principal source of income for certain producers. Production of fescue seed in other areas of the country tends to be more diversified and less monocultural.

In general, seed growers in the Pacific Northwest and the Intermountain regions give special emphasis to perennial and common rye grass; red Chewings and tall fescues; bent grass; Kentucky blue grass; orchard grass; and several wheatgrasses. The bent grasses, historically grown in the New England States, are now grown primarily in Oregon. The stands are primarily on inland irrigated land.

Warm-season grasses are predominant in southern sections of the country where the long growing seasons have high temperatures and plentiful summer precipitation. Much seed is produced in the High Plains of western and southern Texas, as well as in western Oklahoma, Kansas, and Nebraska.

*Corn and sorghum seeds.* Corn and grain sorghum seed tend to be grown in the Corn Belt. Although seed hybrids intended for the South are reproduced in southern climes, seed for the North is reproduced in the Corn Belt. The regional limitations for the reproduction of hybrid grain sorghum are not as great as for corn; for example, sorghum seed intended for Texas may be reproduced in Nebraska and vice-versa. One limitation of sorghum is that seed of grain sorghum must be produced on land where sorghum did not grow the previous year.

*Oats and wheat seeds.* Seeds of oats and wheat may be reproduced in the eastern, southeastern, and Corn Belt areas. Little cross-pollination occurs in cereal crops, so isolation is not necessary. Seed production of cereals usually follows a row crop in the Southwestern States. Cereals in general should follow a cultivated crop so as to minimize weeds.

### *Labor intensity, skill levels, level of automation, productivity, and special considerations*

Degrees of labor intensity in the seed industry vary across the three different subsectors. At the production level, modern farming techniques and equipment have reduced the labor intensity of such operations over the last 30 years. Seed related R&D may be both labor-intensive and highly technological at the same time (for example, manually cross-pollinating plants in a laboratory situation). Such traditional means of seed development as hybridization are both labor and time-intensive.[44] The skill levels required by the various components of the modern seed industry range from the highly skilled practical knowledge of the farmer all the way to the highly skilled technical knowledge of the biochemist, botanist, and genetic engineer using leading-edge-technology laboratories.

Although there is some clash between traditional methods and new developments in seed production[45], the seed industry is starting to benefit from many of the breakthroughs realized by the biotechnology industry. Today, plant-breeding techniques and modern technologies coexist. Agricultural biotechnology contributes greatly to seed production and development. One contribution involves germplasm banks where a source of pure genetic material is stored in case of a disaster. Another biotechnology contribution is the "custom designed" plant. Such a plant may be developed through genetic manipulation, hybridization (bred to be more resistant to certain types of diseases or pests), and cloning. Cloning results in plants with similar dimensions and rates of maturation, thus promoting greater facility in mechanized harvest.

An example of the contributions of agricultural biotechnology can be found with tomato production.[46] Fresh tomato yields in the United States have increased fourfold since 1940, and processing yields have risen fivefold. Resistance to as many as six common diseases has been incorporated into modern varieties and certain F1 hybrids.[47] This progress has occurred

[44] Owing largely to the widely diverse activities involved, wage rate data are not available.

[45] Some segments of the industry warn that the techniques of plant breeding (practical science) must not be lost to biotechnology; those segments also suggest that in fact biotechnology may still be a huge financial risk.

[46] E.C. Tigchelaar, Professor of Horticulture, Purdue University, "Biotechnology vs. Plant Breeding: An Assessment," *Seed Industry*, July 1991.

[47] The F1 hybrid is a cross between two inbred lines. A hybrid must be superior to open-pollinated varieties in one or more characteristics, such as yield, uniformity, and quality, to warrant release as a variety.

in slow, steady increments during the past 50 years at a relatively low cost. The origin of these varieties in the 1940s was a national effort to identify and transfer the resistances from wild relatives to adapted forms, leading to most of the present sources of resistance.

During the first phase of tomato improvement, the public sector portion of the R&D seed subsector played a major role in new cultivar[48] development, but the private sector (seed propagation and marketing) provided the delivery system. However, over the second phase, spanning the last 20 years, the private sector seed R&D firms have become the more prominent players in new cultivar development. The use of hybrids has also dramatically risen, thus permitting the combining of resistances to multiple crop pests. In this example, the changes were evolutionary, and both plant breeding and biotechnology in the R&D subsector played a major role. Additionally, the free exchange of information between the public sector and private firms within the production, marketing, and R&D subsectors was important. As of 1994, the first U.S. government-approved, genetically altered food was marketed: a tomato that stays ripe longer and can be picked at the height of ripeness.[49]

The genetic supply industry is evolving towards the development, production, and supply of a whole spectrum of genetically based products. An example of such a genetically engineered product may not even be a seed, but a process for developing seeds, such as the internationally controversial patent issued by the United States to Agracetus (a subsidiary of W.R. Grace & Co.), dealing with altering the genes of certain plants.

Generally, and especially in the developed world, public and private R&D organizations focus on basic research, while private production and marketing firms concentrate on applied research. In the developing world, the private sector may not be vigorous enough so that public agencies may have to encourage all areas of the industry, including production and marketing.[50]

### *Vertical integration*

Farms producing seeds are neither concentrated nor integrated—horizontally or vertically—to any appreciable degree, except through cooperatives. As noted earlier, the propagation of seeds is done largely through contractual arrangements with independent farmers. There is, however, a trend towards globalization of the seed R&D subsector, especially in those areas involving leading edge biotechnologies. Multinational firms have been expanding into the areas of biotechnology largely through corporate acquisitions. These firms are often fully integrated, and able to function in all aspects of the seed industry.

### *Marketing*

Two factors influence the marketing of seeds: customer demographics and geographic region. Seed marketing firms sell farmers those seeds that are best suited to the climatic and soil conditions where they will be planted, and which tend to be more resistant to plant diseases and pests prevalent in the area. Seeds marketed to gardeners, who tend to be hobbyists and have more time, tend to be of varieties that are more exotic and require more care than those used in large-scale farming operations.

Seeds are introduced as new high-value-added products by the R&D firm that developed them, either directly into the market, or as a licensed product through brokers. Insofar as the product development may take well over a decade, the cost tends to be high since the firm having developed the new variety needs to amortize its R&D and initial marketing expenses. Over time, and especially in the case of self-pollinated seed, others begin to produce the new variety—perhaps under a different name, or for personal use—and the variety becomes a mature product.[51] In the case of hybrids, a similar process is at work: competition through research and the introduction of improved or specially adapted varieties. It is unusual for a hybrid to remain a leader in a particular market for more than 6 or 7 years.[52] The special adaptations bred into seeds provide some exceptions to the cycle: varieties successful in a particular region may be quite unsuitable to another region, and thus will not be exported once propagated.

### *Research and development expenditures and high technology processes*

The development of improved plant varieties for food, fiber, and ornamental purposes is both expensive and time consuming. It can cost $1 million in research *alone* to develop a significant and successful new variety.[53]

---

[48] A cultivar is a variety of plant that has only been produced under cultivation.

[49] The Flavr-Savr, developed by Calgene, Inc.

[50] McMullen, Neil, *Seeds and World Agricultural Progress*, National Planning Association (Wash., D.C., 1987).

[51] The pricing and marketing of seeds is a practical example of the Product Life Cycle Theory of economics. According to this theory, products go through a cycle of being introduced as new, often high technology products. These products then become increasingly common over a period of years, and ultimately are produced as relatively standardized lower technology goods.

[52] McMullen, op. cit., ch. 4, "The Internationalization of the Seed Industry."

[53] From the Statement of Pioneer Hi-Bred International, Inc. to the Department Operations and Nutrition Subcommittee of the House Committee on Agriculture on H.R. 2927, Amendments to the Plant Variety Protection Act, May 24, 1994.

The members of a given species of plants typically share a number of well-established physical characteristics associated with the genetic materials of their cells; these characteristics are known as phenotypes.[54] However, plants of a given species having one or more new and distinctive characteristics, generally referred to as sports or mutations, occur naturally as a small fraction of any plant population. For centuries, mutants have been selectively bred to produce new varieties or modifications of existing plants. In natural populations of plants, however, the frequency of mutations is generally considered to be less than 1 in 500,000, so that the selection of desirable mutants after such breeding is slow and laborious, particularly so because it is well recognized that mutants exhibiting a desirable phenotype are rare, and progeny outputs are often low.

Several methods for increasing the occurrence of mutants in a population of a given species are known; for example, the exposure of such a population to ionizing radiation. Such techniques, however, are typically subject to a number of drawbacks. Resulting mutants are generally weak, and must still be subjected to the time-consuming and labor-intensive techniques of isolation and selective breeding for a large number of generations, before a sufficient number of mutants possessing the new phenotype are obtained for use in outcrossing or agricultural growth.

Recombinant DNA and protoplast fusion techniques are potentially useful for producing new varieties of plants without isolation of mutants or selective breeding. However, these techniques may be expensive, tedious, and slow, requiring elaborate instrumentation involving a large number of chemical processes, and a substantial investment in the education and training of the personnel conducting the procedures.

A recently patented method[55] provides a way to increase the number of mutants exhibiting altered phenotypic characteristics. Such characteristics are stable in successive generations, where such phenotypic characteristics are an established trait of a second different species of a plant. The new method involves placing germinal plants of a first species (exhibiting at least one established phenotype) in contact with the whole cells and associated materials of a second species of plant. The germinal plants of the first species are then exposed to an electric current.[56]

[54] The information on biotechnology is taken from *Method For Producing New Varieties of Plants*, Patent No. 5,288,626, issued Feb. 22, 1994, to William C. Levengood.

[55] Ibid.

[56] The electric current is defined in the patent as—"electrophoretic conditions, such as an iontophoretic current."

Another newly patented method[57] involves the use of a plant pathogen, such as *agrobacterium tumafaciens*, to genetically transform the cells of plants. The foreign gene construction is then included in the cells of the whole plant regenerated from the transformed cells, and is then inherited in the same manner as other traits.

The Office of Technology Assessment (OTA), an agency of the U.S. Congress, studied U.S. technological development in agriculture and the subsequent transfer of such technology abroad to competitors. This study encompassed all U.S. agricultural production, including seeds. The OTA concluded that technology transfer is indeed a factor in explaining changes in U.S. agricultural competitiveness in the 1980s.[58] The OTA concluded that the increasing ease with which new technology is disseminated worldwide is "closing the gap" between U.S. producers and their foreign competition.

Public germplasm research has been conducted in the United States for over a century and is the primary responsibility of the State Agricultural Experiment Stations (SAES), which employ about 6,000 faculty nationwide.[59] Approximately 350 SAES scientists are plant breeders who have been directly involved in the development of improved germplasm for food, fiber, and ornamental crops. A number of SAES scientists contribute to improved genome[60] technology through the training of geneticists, plant breeders, biotechnologists, and other plant scientists.

### *U.S. Government programs*

U.S. agricultural programs are extensive and complex. Though these programs are not aimed at the

[57] "Genetic Engineering of Cotton Plants and Lines," U.S. Patent No. 5,159,135, assigned to Agracetus, Inc., Oct. 27, 1992; although specific to cotton, the seed of which is not covered in this summary, the techniques discussed in this patent are applicable to other seeds, such as tobacco.

[58] U.S. Congress, Office of Technology Assessment, *Technology, Public Policy, and the Changing Structure of American Agriculture*, OTA-F-285 (Washington, DC.; U.S. Government Printing Office, Mar. 1986); and U.S. Congress, OTA, *A Review of U.S. Competitiveness in Agricultural Trade—A Technical Memorandum*, OTA-TM-TET-29 (Washington, DC.; U.S. Government Printing Office, Oct. 1986); as discussed in USITC, *U.S. Global Competitiveness: Oilseeds and Oilseed Products, Report To the Committee on Finance, U.S. Senate, Investigation No. 332-240, Under Section 332(g) of the Tariff Act of 1930*, USITC publication 2045, Dec. 1987); also as discussed in USITC, *Industry & Trade Summary, Oilseeds*, USITC publication 2478 (AG-4), Jan. 1992.

[59] Richard L. Lower, University of Wisconsin-Madison, in testimony presented to the Agriculture Committee of the U.S. House of Representatives on May 24, 1994, on behalf of the Experiment Station Committee on Operations Planning, National Association of State Universities and Land Grant Colleges.

[60] Genome pertains to chromosome sets.

development and propagation of seeds, they have both positive and negative impacts on the demand for certain seeds in the United States. The most relevant of these programs are those for grains. Government programs supporting the grains sector have a direct impact on the demand for seeds by producers of grains. If the government programs encourage more grain acreage, then more seeds will be marketed. On the other hand, production-adjustment programs such as the Acreage Reduction Programs[61] (ARP) lessen the demand for seeds to plant cereal crops. Conversely, the demand for seeds for cover crops, such as clovers and various grass seeds, are enhanced by programs such as ARP.

There are no U.S. Government programs for flower or vegetable seeds, or for general seed development. However, as mentioned earlier, public sector research plays an important role in basic seed research.

The United States is a primary participant in the three-country North American Plants Protection Organization (NAPPO). The NAPPO provides a North American, continental approach to plant protection by affording a means of sharing information and furthering common goals in plant health activities. Comprised of Federal plant protection officials of Canada, the United States, and Mexico, NAPPO was created in 1976. As an affiliate of the United Nation's Food and Agriculture Organization (FAO), NAPPO adheres to the International Plant Protection Convention. NAPPO focuses on the development of regional phytosanitary standards that can be used by member countries to avoid or resolve disputes.[62]

### *Extent of globalization*

It is difficult to view the seed industry outside of a global context. First, there is a match between public—both national and international—and private sectors in product development and dissemination. Second, seed propagation firms traditionally take advantage of the seasonal reversals on either side of the Equator. For example, owing to differences in climate and seasons, as well as the availability of land, United States farmers may propagate seeds under contract to Japan; however, U.S. seed firms may also be propagating seeds for domestic or international use in South America. Of the more than 500 companies listed in the seed industry buying guide, 112 are companies from many foreign countries: South Africa, India, Pakistan, Taiwan, Japan, Korea, Holland, France, Denmark, England, Belgium, Germany, Switzerland, New Zealand, Australia, Mexico, and Canada.[63]

Among the top 23 firms involved with seeds globally, more than one-half are based in the United States. European firms[64], especially French firms[65], have been forerunners in plant breeding. Four European groups in particular stand out[66]: ICI Seeds (United Kingdom), with seed and seed-related sales in excess of $250 million; Limagrain (France), with sales in excess of $440 million; and Sandoz, with sales in excess of $625 million (Switzerland). Two Japanese firms (Takii and Sakata) have challenged the Europeans firms, especially in the more specialized areas of horticultural seeds.

U.S. firms have frequently established operations in other nations to supply the local market and to export from those platforms into the world market. For example, U.S. corn research in New Zealand is valued at $3 million annually. Further, most U.S. companies that grow corn seed in New Zealand export those seeds to Europe. Corn seed from New Zealand is on the U.S. seed quarantine list.[67]

## Consumer Characteristics and Factors Affecting Demand

Nearly all plant-based agriculture involves the use of seeds. Even the most primitive of farming operations must set aside seed for the next crop, and must take into account what will and will not grow well in a region. Industrial farming operations, which tend to specialize in one crop, rely heavily on seed companies to provide reliable seed—often certified[68]—having desirable characteristics for a

[61] This program is designed to reduce a farmer's acreage, and hence support prices through reduced production. The ARP is a percentage of a program-participating farmer's acreage that must be idled as a condition to receiving farm program benefits. ARP percentages are established differently depending on the crop involved. For more information, see USDA, Provisions of the Food, Agriculture, Conservation, and Trade Act of 1990, Agriculture Information Bulletin No. 624, June 1991.

[62] From the NAPPO information brochure, *NAPPO, North American Plant Protection Organization, Its Purpose, Projects, Goals, and Policies*, published by the Executive Secretary, NAPPO, C/O Plant Protection Division, Agriculture Canada, K.W. Neatby Building, 960 Carling Avenue, Ottawa, Ontario, Canada K1A OC6.

[63] *Seed World, 1992 Seed Trade Buyers Guide*, op. cit.

[64] All of these firms have subsidiaries worldwide, including some inside the United States.

[65] Vilmorain, Groupe Limagrain, celebrated its 250th anniversary in 1992.

[66] Bernard Tixier, "Europe's Largest Seed Breeders: An Update," *Seed World*, vol. 129, No. 12 (Nov. 1991); and Agri Europe, Aug. 26, 1994, op. cit.

[67] "USDA would allow New Zealand to export seed corn to U.S. for research," *Milling & Baking News*, June 15, 1993.

[68] Certified seeds are inspected and have government issued certificates attesting to variety and purity, among other factors.

region, style of farming, type of soil, and type of machinery.[69]

Even at a high price, seeds usually constitute a fairly small percentage of the production costs of a crop. Thus, end-user demand for seeds tends not to be very sensitive to seed prices. On the other hand, the seed industry is highly dependent on profits to finance emerging technologies, and to absorb the costs of the time lags involved in producing a new or improved variety. The time needed to develop a new variety may be more than 12 years, whereas the product life expectancy of the new seed will be about 6 to 7 years. Thus, the seed industry is responsive to higher prices and to mechanisms that serve to protect their profits such as strong and well-enforced laws protecting IPR.

The consumers (end-users) of seeds for sowing fall into two broad categories: agricultural operations and home gardeners. No one knows the number of consumers of seeds; there was an estimate of 2.1 million farms in 1992.[70] Nor is the number of home gardeners known,[71] although in 1990 there were more than 10,000 retail nurseries and garden stores to supply the demand from home gardeners.[72] The total number of consumers would also include all consumers of U.S. seeds overseas.

For farms, for which the cost of production and profit (marketability and yield) are paramount, the major seed characteristics affecting demand for seed are these: germination rate;[73] consistency;[74] resistance to pests, drought, and disease; appearance; yield;[75] purity;[76] end-use processing characteristics;[77] identity acceptability;[78] and government certification. Although these characteristics matter some to home gardeners, resistance[79] and consistency matter less to them, and an enhanced selection in varietals is actually important.

[69] For example, according to Mr. Libman of the Libman Co. in Arcola, IL, the U.S. broom corn industry is working on developing a new variety of broom corn that will grow to a uniform height. This would permit mechanized harvesting, and the broom corn industry hopes a revitalization of the U.S. broom-corn-producing sector.

[70] U.S. Department of Commerce, *Statistical Abstract of the United States 1993*, table 1100.

[71] The number of home gardens is not known, however, a Gallup poll is cited in the *Statistical Abstract*, table 405. The 1991 overall home garden and lawn market is estimated at over $22 billion.

[72] *Statistical Abstract*, table 1300.

[73] This is the percentage of the seeds that will germinate.

[74] This is the degree of similarity of the mature product, in terms of size, date ready for harvest, height, etc. This is important from a marketing point of view and for the optimal use of harvesting machinery.

[75] In terms of output per acre or hectare.

[76] Percentage of weed seeds or other varietals mixed in with the seed.

[77] If the product is used as an input, will it provide the optimal characteristics required by the industrial processor? For example, not all durum wheat—grades and varieties—is considered to be of acceptable milling quality by the producers of high-end pasta products. Further, in Canada, there is strict varietal control when it comes to the production of wheat.

[78] This characteristic deals with whether the seeds of a particular variety will be acceptable in the markets, nations, or industries it targets.

# INTELLECTUAL PROPERTY RIGHTS

The question of IPR has become vitally important to developers of new seeds and plant varieties worldwide. Two factors contribute to their concern with IPR. First, much of the value added in seed development is knowledge that can be embodied in the seed at a relatively low cost once the initial research expenses have been met. Second, self-pollinated seeds can be reproduced by the farmer at little additional cost after a one-time seed purchase. Seed breeders are very concerned with technology transfers and legal protection of IPR related to seed R&D. Without IPR protection, the profits of the firms developing new seeds and new plant varieties or of seed R&D firms, are seriously jeopardized. These profits are necessary to finance additional research.

## Plant Variety Intellectual Property Rights

Developers of new seeds and plant varieties have come to regard intellectual property rights as vitally important to their industry. Industry sources report that the development of new plant varieties is an arduous, time consuming and costly process. Owners assert that by granting them the right to prevent unauthorized sale of seed of a variety, they will recover the cost of development and fund further research in new varieties that respond to the changing needs of American agriculture. In recent years such research is said to have taken on even greater importance in view of increasing concern over the use of agricultural chemicals, the ever changing picture of plant pests and disease and increasing world-wide demand for food production.

### Plant breeders' rights, patent laws: The national system

In the United States there are three distinct systems for the protection of plants and plant varieties:

1. The Plant Patent Act of 1930 (PPA),[80] provides protection for any distinct and new variety of *asexually reproduced*[81] plants (such as a variety of rose), including cultivated sports, mutants, hybrids and newly

[79] However, resistance is increasingly important to those who wish to garden organically, or just to limit the use of garden chemicals.

[80] 35 U.S.C. §161, *et seq.*

[81] Asexual reproduction includes grafting, budding, cuttings, layering, division and the like, but not reproduction by seed. *Kim Bros. v. Hagler*, D.C. Cal. 1958, 167 F. Supp. 665, aff'd. 276 F. 2d 259.

found seedlings, other than a tuberpropagated plant (potatoes, *e.g.*) or a plant found in an uncultivated state. A patent under the PPA is granted for a term of 17 years and conveys the right to exclude others from asexually reproducing the plant or selling or using the plant so produced. The PPA is administered by the United States Patent and Trademark Office (PTO). Under the PPA, each application is limited to a single formal claim for the plant variety shown and described in the application. In order to obtain protection, the applicant must demonstrate that the claimed variety is new, distinct and unobvious.

2. The Plant Variety Protection Act of 1970[82] (PVPA) provides *sexually reproduced*[83] varieties (such as soybeans, wheat and cotton) with protection similar in scope to the protection provided by the PPA for asexually reproduced varieties. Fungi, bacteria and genes are excluded from PVPA protection. The PVPA is administered by the USDA. A Certificate of Protection obtained under the PVPA is valid for a term of 20 years (25 for trees and vines) and provides the owner with the right to exclude others from selling, offering for sale, reproducing, importing, exporting or using the protected plant variety during the term. In order to obtain protection, a breeder must demonstrate that the variety for which protection is sought is new, distinct, uniform, and stable.

3. The Patent Act of 1952 (PA)[84] provides utility patent protection for inventors of "any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof."[85] In recent years, United States utility patent protection has been interpreted to encompass human-made life forms, including plant life,[86] provided such life forms meet the traditional patent tests of novelty, utility, and unobviousness.[87] Where appropriate, much broader exclusionary rights are available under the laws governing utility patents than under the PPA or PVPA.

[82] 7 U.S.C § 2321-2582.

[83] The term "sexually reproduced" includes any production of a variety by seed 7 U.S.C. § 2401 (f).

[84] 35 USC § 1, *et seq.*

[85] 35 USC § 101.

[86] *Diamond v. Chakrabarty* 447 U.S. 303, 100 S.Ct. 2204, 206 USPQ 193 (U.S. Supreme Court, 1980), held patentable (as a utility patent) a human-made micro-organism for degrading several different components of crude oil. A 1985 decision of the Patent and Trademark Office Board of Appeals and Interferences made it clear that the PTO considers the *Chakrabarty* decision as having extended utility patent protection to human-made plant life. *Ex Parte Hibberd*, 227 USPQ 443 (1985).

[87] 35 U.S.C. § 103 provides that: "A patent may not be obtained... if the differences between the subject matter

The PPA, enacted in 1930, provided patent rights for the first time to breeders of asexually reproduced plant varieties. Sexually or seed reproduced plant varieties were not included in the PPA because common perception at the time was that such varieties were not sufficiently identifiable, uniform and stable to be protectable. However, by 1961, after it became apparent that this was not the case, interest developed in providing breeders with rights similar to those provided for asexually reproduced plants under the PPA. The American Seed Trade Association (ASTA) established a Breeders' Rights Study Committee to investigate ways of providing legal protection to breeders of seed-reproduced varieties, and ultimately the PVPA was enacted as a result of such efforts.

The PVPA established a Plant Variety Protection Office (PVPO) in the USDA to administer the PVPA and to maintain a register of descriptions of U.S.-protected sexually reproducing plant varieties. The PVPA was amended in 1980 to bring the Act into conformity with the 1978 International Union for the Protection of New Varieties of Plants (UPOV) Convention. In October of 1994, the PVPA was again amended to conform to changes required by the 1991 UPOV Convention.[88]

In order to obtain protection under the PVPA, a novel variety must be "distinct." The PVPA defines distinctness as any clear difference that distinguishes the novel variety from all prior varieties publicly known or a matter of common knowledge at the time of the filing of the application. The distinctness of one variety from another may be based on one or more identifiable morphological, physiological, or other characteristics (including any characteristics evidenced by processing or product characteristics, such as milling and baking characteristics in the case of wheat) with respect to which a difference in genealogy may contribute evidence. Advances in biochemistry and genetics have made it possible to distinguish a variety on the basis of a single amino acid change in a DNA structure. The 1994 Amendments to the PVPA,[89] have responded to such technological advances by creating a category of "essentially derived varieties." The PVPA now provides that owners of varieties determined to be "initial" varieties may exclude the selling or marketing of any varieties determined to be essentially derived

[87] *Continued*—sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains."

[88] Plant Variety Protection Act Amendments of 1994, Pub.L. No. 103-349, 108 Stat. 3136, *et seq.* (1994). For further background, see, House Comm. on Agriculture, Plant Variety Protection Act Amendments of 1994, H. R. Rep. No. 699, 103rd Cong., 2d Sess. (1994).

[89] Ibid.

varieties, *i.e.*, varieties that have been obtained by altering just slightly the successful varieties of others are now clearly categorized as infringing under the PVPA.[90]

The PVPA has two exemptions to the rights granted to certificate holders that are not found under the PPA or PA. First, there is a research exemption, which allows for the sale or disposition of a variety of harvested material from a protected variety for the purposes of experimentation and testing. Second, the PVPA provides a crop exemption or farmer's exemption which allows a person whose primary farming occupation is the growing of crops for sale for other than reproductive purposes, to save seed from his or her harvested crop. This saved seed may then be replanted by the farmer. Unless the farmer obtains permission from the certificate holder, the sale of saved seed for reproductive purposes (so called "brown bag sales") is now prohibited by the PVPA.[91]

### Plant breeders' rights, patent laws, and UPOV: The international system

Industry sources indicate that seed developers and breeders will restrict their participation in international trade in the absence of a uniform system to protect plant variety intellectual property. UPOV[92] is an agreement between countries which provides a minimum level of protection for plant varieties on the basis of standard criteria. The UPOV organization is headquartered in Geneva. As under the PVPA, breeder's rights are conferred on a variety when it is determined that the variety is novel, distinct, uniform and stable. A minimum of 15 years protection is given for most plants. Any protected variety must be freely available for research involved in developing other varieties. The United States joined UPOV in 1981.

UPOV has had two Conventions, in 1978 and in 1991. Amendments to the PVPA, enacted on October 6, 1994,[93] brought the PVPA into conformity with the provisions of the 1991 UPOV convention. Major changes provided by the 1994 PVPA amendments include: the prohibition of unauthorized "brown bag sales," as noted above; extension of proprietary protection to harvested materials of protected varieties; replacement of the PVPA "first to invent" system with a first-to-file system; extension of the term of a certificate of protection from 18 to 20 years for most crops, and from 18 to 25 years for trees and vines; extension of protection to first generation hybrids; a requirement that protected varieties be sold by variety name only (with certain narrow exemptions); establishment of a category of "essentially derived varieties" which, as noted above, enables the owner of an "initial" variety to exclude the selling or marketing of varieties that differ only slightly from the initial variety.[94]

### Developments under the Uruguay Round

The GATT Uruguay Round Agreements (URA) include an Agreement on Trade- Related Aspects of Intellectual Property Rights which, when implemented by member countries of the new World Trade Organization (WTO), is regarded as being likely to improve protection for U.S. plant varieties in those member countries that are not signatories to the UPOV.

## Foreign Industry Profile

Virtually every nation in the world produces seeds, although not all are produced commercially. In traditional areas, seeds are often produced, stored, and sown on the same farms. Although the seed industry is international, systematic data or analysis on seeds and the seed industry is scarce.[95] This lack of data arises from the diversity of industries and institutions that come together for the purpose of seed development and production, as well as the preoccupation of seed companies with protecting their IPR once a new cultivar has been developed. Further, in the past, although the marketing of seeds is a well-established worldwide business, the seed industry as a modern, integrated, well-capitalized, professionally managed agricultural activity is rather young.

To supply data and analysis of the seed industry, organizations such as the Consultative Group on International Agricultural Research (CGIAR) were established.[96] The CGIAR is a voluntary association that focuses on collecting, maintaining, and improving plant genetic sources such as seeds. It consists of about 40 nation-donors that support an international network of 18 agricultural and natural resource research centers. These 18 research centers are located

[90] 7 U.S.C. 2541(c)(1).
[91] 7 U.S.C. 2543.
[92] UPOV, *International Convention for the Protection of New Varieties of Plants of Dec. 2, 1961 and Additional Act of Nov. 10, 1972 and Revised Text of Oct. 23, 1978* (Geneva 1985).
[93] Plant Variety Protection Act Amendments of 1994, Pub.L. No. 103-349, 108 Stat. 3136, *et seq.* (1994).
[94] For further background, see, House Comm. on Agriculture, Plant Variety Protection Act Amendments of 1994, H. R. Rep. No. 699, 103rd Cong., 2d Sess. (1994).
[95] McMullen.
[96] From information provided by Dana G. Dalrymple, U.S. Agency for International Development (USAID), and from *Diversity* (vol. 9, No. 3, 1993).

throughout the world in both developing and developed countries.[97] In developed and developing nations alike, these research centers chiefly focus on the agricultural sectors of the developing countries. The United States, through the Agency for International Development, helped organize the CGIAR in 1972 and, until 1993, was the leading donor. The CGIAR is funded through the World Bank (the leading donor and the Secretariat), the United Nations Development Program, and the UN-sponsored Food and Agriculture Organization.

The CGIAR centers focus on the genetic resources (seeds) of the major food crops for domestic consumption in developing nations as well as food policy, irrigation, forestry, and aquatic resources. Most programs are carried out in close cooperation with national agricultural research systems that tailor the final research projects to meet local conditions. Emphasis is given to applied biological research for use at the farm level.

The CGIAR collects, and improves through breeding, plant genetic resources. Ten of the centers maintain gene banks and together they represent the world's largest stock of plant genetic resources (over 500,000 accessions in total). Another center, the International Plant Genetic Resources Institute in Rome, provides leadership and coordination to genetic resources programs in developing nations and will increasingly represent the genetic resources activities in the CGIAR system. Center genetic resources are freely available to all who are interested.

Developed market economies such as France, Australia, and Canada tend to have more advanced private seed industries than developing countries, although the seed industries of developed nations also rely on the services of publicly funded agricultural research institutes. For example, the French Government funds the National Institute for Research and Agronomy, while Australia has a system of state universities, similar to the U.S. land-grant college system, to sponsor agricultural and seed research. Canada has the Grain Research Laboratory of the Canadian Grain Commission, a Canadian Government corporation, that conducts seed-related research, including evaluation of the climatic adaptability of new wheat varieties and development of wheat varieties that meet the quality requirements of Canada's overseas clients.[98] Seed industries of developing countries, on the other hand, rely more heavily on public and international institutions than industries of developed countries. One example is the International Rice Research Institute in Los Baños, Laguna, Philippines. In developing countries, farmers operating at or near subsistence do not have the purchasing power to procure improved cultivars. Further, very poor farmers have a reluctance to pay for seeds, which they have traditionally viewed as a free input. Impediments to the marketing of seeds in developing nations include—

*The agricultural risk element,* where the new seeds may not be as productive as the tried-and-true traditional varieties;

*The financial risk element,* where additional purchased inputs may be required to achieve the potential of the new seeds, such as pesticides and fertilizers, which the farmer cannot afford to buy. Also, the farmer of the developing nation may not have the knowledge to utilize these additional inputs.

*A problem of "extension" service,* where poor, isolated farmers are unaware of the seed technology available to them.

A typical example of a developing nation's seed industry may be observed in India, which has been characterized as "one of the largest seed markets in the world, but [one] almost entirely supplied by domestically produced seed."[99] India's efforts have focused on the development of superior cultivars through public-sector seed company efforts. Private sector seed development in India is hampered by the absence of a system of varietal protection.

The Indian multiplication chain for seeds has three stages:

*Nucleus seed* evolves from the efforts of a public sector plant breeder;

*Breeder seed* and *foundation seed* are bred at state agricultural universities, not dissimilar to U.S. land grant institutions, and at government agricultural research institutions under the aegis of the Indian Council of Agricultural Research;

*Production seed* is developed and distributed by the National Seed Corporation.

# U.S. TRADE MEASURES

## Tariff Measures

Table 2 lists the 1994 general and special rates of duty along with the bound rates of duty that are scheduled to go into effect under recently enacted U.S. legislation implementing the GATT URA. Table 2 also includes 1993 seed export and import data. In 1994,

[97] The CGIAR global network is comprised of centers in Colombia, Mexico, Indonesia, Peru, Italy, Syria, the Philippines (two centers), Kenya (two centers), India, the United States, Sri Lanka, Nigeria, Ethiopia, France, the Netherlands, and the Ivory Coast.

[98] C. Wilson, *Grain Marketing In Canada* (Winnipeg, Manitoba, Canada: Canadian International Grains Institute, 1979, p. 78. See also USITC, *Wheat, Wheat Flour, and Semolina* (investigation No. 22-54), USITC publication 2794, July 1994, p. II-54.

[99] U.S. Department of State, "Seeds Annual Report," prepared by U.S. Embassy, New Delhi, India, Dec. 15, 1993 (AGR No.: IN3112).

**Table 2**
**Seeds and mushroom spawn: Harmonized Tariff Schedule subheading; description; U.S. col. 1 and special rates of duty as of Jan. 1, 1994; URA rates; U.S. exports, 1993; U.S. imports, 1993**

| HTS & Export subheading | Description | Col. 1 rate of duty as of Jan. 1, 1994 | | Bound duty, Uruguay Round[2] | U.S. exports, 1993 | U.S. imports, 1993 |
|---|---|---|---|---|---|---|
| | | General | Special[1] | | | |
| | | | | | – *Thousand dollars* – | |
| 0602.91.00 | Mushroom spawn | 2.2¢/kg | Free (CA,E,IL,J,MX) | 1.4¢/kg | 12,927 | 332 |
| 0712.90.80.50 | Sweet corn seeds of a kind used for sowing | 13% | Free (A,E,IL,J,MX) 5.2% (CA) | 8.3% | 25,175 | 1,681 |
| | Dried leguminous vegetable seeds of a kind used for sowing: | | | | | |
| 0713.10.10 | Peas | 3.3¢/kg | Free (A,CA,E,IL,J,MX) | 1.5¢/kg | 13,344 | 5,448 |
| 0713.20.10 | Chickpeas | 3.3¢/kg | Free (A,CA,E,IL,J,MX) | 1.5¢/kg | 203 | 80 |
| 0713.31.10 | Mung beans | 3.3¢/kg | Free (A,CA,E,IL,J,MX) | 0.8¢/kg | 3,178 | 3,524 |
| 0713.32.10 | Small red beans | 3.3¢/kg | Free (A,CA,E,IL,J,MX) | 1.5¢/kg | 178 | 96 |
| 0713.33.10 | Kidney and white pea beans | 3.3¢/kg | Free (A,CA,E,IL,J,MX) | 1.5¢/kg | 13,756 | 1,177 |
| 0713.39.10 | Other beans | 3.3¢/kg | Free (A,CA,E,IL,J,MX) | 1.5¢/kg | 1,889 | 5,992 |
| 0713.40.10 | Lentils | 3.3¢/kg | Free (A,CA,E,IL,J,MX) | 1.5¢/kg | 253 | 1,085 |
| 0713.50.10 | Broad beans and horse beans | 3.3¢/kg | Free (A,CA,E,IL,J,MX) | 1.5¢/kg | 239 | 300 |
| 0713.90.10 | Other dried leguminous vegetables | 3.3¢/kg | Free (A*,CA,E,IL,J,MX) | 1.5¢/kg | 2,593 | 357 |
| | Cereal seed of a kind used for sowing: | | | | | |
| 1001.10.00.10 | Durum wheat | 0.77¢/kg | Free (E,IL,J) 0.3¢/kg (CA) 0.6¢/kg (MX) | 0.65¢/kg | (3) | 139 |
| 1001.90.10 | Other wheat | 6.3% | Free (E,IL,J,MX) 2.5% (CA) | 2.8% | 5,799 | 1,456 |
| 1004.00.00.10 | Oats seed | Free | | Free | (3) | 263 |
| 1005.10.00 | Corn (maize) seed | Free | | Free | 167,619 | 29,304 |
| 1007.00.00.20 | Grain sorghum seeds of a kind used for sowing | 0.88¢/kg | Free (A,CA,E,IL,J,MX) | 0.22¢/kg | 34,494 | 81 |
| | Seeds of a kind used for sowing: | | | | | |
| 1209.11.00 | Sugar beet seed | Free | | Free | 3,457 | 391 |
| 1209.19.00 | Other beet seed | Free | | Free | 2,688 | 15 |
| 1209.21.00.20 | Certified alfalfa (lucerne) seed | 3.3¢/kg | Free (A,CA,E,IL,J,MX) | 1.5¢/kg | 26,015 | 704 |

Source: See footnotes at end of table

**Table 2—Continued**
**Seeds and mushroom spawn: Harmonized Tariff Schedule subheading; description; U.S. col. 1 and special rates of duty as of Jan. 1, 1994; URA rates; U.S. exports, 1993; U.S. imports, 1993**

| HTS & Export subheading | Description | Col. 1 rate of duty as of Jan. 1, 1994 | | Bound duty, Uruguay Round[2] | U.S. exports, 1993 | U.S. imports, 1993 |
|---|---|---|---|---|---|---|
| | | General | Special[1] | | | |
| | | | | | – *Thousand dollars* – | |
| 1209.21.00.40 | Other alfalfa (lucerne) seed | 3.3¢/kg | Free (A,CA,E,IL,J,MX) | 1.5¢/kg | 8,403 | 3,650 |
| | Clover seed: | | | | | |
| 1209.22.20 | White and ladino | 3.5¢/kg | Free (CA,E,IL,J,MX) | 1.6¢/kg | 1,764 | 1,433 |
| 1209.22.40.20 | Alsike | Free | | Free | (3) | 1,039 |
| 1209.22.40.30 | Crimson | Free | | Free | 1,698 | 21 |
| 1209.22.40.40 | Red | Free | | Free | 2,034 | 3,930 |
| 1209.22.40.60 | Sweet | Free | | Free | (3) | 911 |
| 1209.22.40.95[4] | Other | Free | | Free | 331 | 427 |
| | Fescue seed: | | | | | |
| 1209.23.00.20 | Tall | Free | | Free | 4,017 | 1,137 |
| 1209.23.00.30 | Creeping red | Free | | Free | (3) | 12,755 |
| 1209.23.00.50[5] | Other | Free | | Free | 5,215 | 1,039 |
| | Other seeds of forage plants: | | | | | |
| 1209.24.00 | Kentucky blue grass | 2.75¢/kg | Free (CA,E,IL,J,MX) | 1.2¢/kg | 6,750 | 894 |
| 1209.25.00.20 | Annual rye grass | 2.2¢/kg | Free (CA,E,IL,J,MX) | 1.4¢/kg | 3,695 | 329 |
| 1209.25.00.40 | Perennial rye grass | 2.2¢/kg | Free (CA,E,IL,J,MX) | Free | 5,640 | 6,893 |
| 1209.26.00 | Timothy grass | Free | | Free | 1,729 | 2,637 |
| 1209.29.00.20 | Bent grass | Free | | Free | 5,165 | 92 |
| 1209.29.00.30 | Birdsfoot trefoil | Free | | Free | (3) | 962 |
| 1209.29.00.35 | Bromegrass | Free | | Free | (3) | 2,030 |
| 1209.29.00.40 | Orchard grass | Free | | Free | 2,527 | 1,195 |
| 1209.29.00.60 | Sudan grass | Free | | Free | 1,540 | 0 |
| 1209.29.00.70 | Wheatgrass | Free | | Free | (3) | 594 |
| 1209.29.00.90[6] | Other | Free | | Free | 14,038 | 1,889 |
| 1209.30.00 | Seeds of herbaceous plants cultivated principally for their flowers | 2.2¢/kg | Free (A,E,IL,J,MX) 0.8¢/kg (CA) | 1.0¢/kg | 19,380 | 31,772 |
| | Vegetable seeds of a kind used for sowing: | | | | | |
| 1209.91.10 | Cauliflower | 13.2¢/kg | Free (E,IL,J,MX) 5.2¢/kg (CA) | 5.9¢/kg | (3) | 2,084 |

Source: See footnotes at end of table

**Table 2—Continued**
**Seeds and mushroom spawn: Harmonized Tariff Schedule subheading; description; U.S. col. 1 and special rates of duty as of Jan. 1, 1994; URA rates; U.S. exports, 1993; U.S. imports, 1993**

| HTS & Export subheading | Description | Col. 1 rate of duty as of Jan. 1, 1994 | | Bound duty, Uruguay Round[2] | U.S. exports, 1993 | U.S. imports, 1993 |
|---|---|---|---|---|---|---|
| | | General | Special[1] | | | |
| | | | | | – *Thousand dollars* – | |
| 1209.91.20 | Celery | Free | | Free | (3) | 1,570 |
| 1209.91.40 | Onion | Free | | Free | 14,170 | 3,942 |
| 1209.91.50 | Parsley | 1.5¢/kg | Free (E,IL,J,MX) 0.6¢/kg (CA) | 0.68¢/kg | (3) | 90 |
| 1209.91.60 | Pepper | Free | | Free | 5,328 | 10,367 |
| 1209.91.80.10 | Carrot | 3.3¢/kg | Free (A,E,IL,J,MX) 1.3¢/kg (CA) | 1.5¢/kg | 9,053 | 1,013 |
| 1209.91.80.20 | Radish | 3.3¢/kg | Free (A,E,IL,J,MX) 1.3¢/kg (CA) | 1.5¢/kg | 4,904 | 299 |
| 1209.91.80.30 | Spinach | 3.3¢/kg | Free (A,E,IL,J,MX) 1.3¢/kg (CA) | 1.5¢/kg | 5,928 | 1,521 |
| 1209.91.80.40 | Cucumber | 3.3¢/kg | Free (A,E,IL,J,MX) 1.3¢/kg (CA) | 1.5¢/kg | 10,169 | 3,387 |
| 1209.91.80.50 | Lettuce | 3.3¢/kg | Free (A,E,IL,J,MX) 1.3¢/kg (CA) | 1.5¢/kg | 3,125 | 915 |
| 1209.91.80.60 | Squash | 3.3¢/kg | Free (A,E,IL,J,MX) 1.3¢/kg (CA) | 1.5¢/kg | 8,512 | 2,949 |
| 1209.91.80.70 | Tomato | 3.3¢/kg | Free (A,E,IL,J,MX) 1.3¢/kg (CA) | 1.5¢/kg | 13,572 | 16,166 |
| 1209.91.80.80[7] | Other | 3.3¢/kg | Free (A,E,IL,J,MX) 1.3¢/kg (CA) | 1.5¢/kg | 51,374 | 9,171 |
| | Other seeds of a king used for sowing: | | | | | |
| 1209.99.20 | Tree and shrub seeds | Free | | Free | 1,762 | 1,884 |
| 1209.99.40.20 | Cantaloupe seeds | 3.3¢/kg | Free (A,E,IL,J,MX) 1.3¢/kg (CA) | 0.83¢/kg | 6,536 | 4,004 |
| 1209.99.40.40 | Watermelon seeds | 3.3¢/kg | Free (A,E,IL,J,MX) 1.3¢/kg (CA) | 0.83¢/kg | 9,192 | 5,572 |
| 1209.99.40.70 | Tobacco seeds | 3.3¢/kg | Free (A,E,IL,J,MX) 1.3¢/kg (CA) | 0.83¢/kg | 349 | 0 |
| 1209.99.40.80 | Other seed | 3.3¢/kg | Free (A,E,IL,J,MX) 1.3¢/kg (CA) | 0.83¢/kg | 12,647 | 12,714 |

[1] Programs under which special tariff treatment may be provided, and the corresponding symbols for such programs as they are indicated in the "Special" subcolumn, are as follows: Generalized System of Preferences (A or A*); North American Free-Trade Agreement: good from Canada (CA), good from Mexico (MX); Caribbean Basin Economic Recovery Act (E or E*); United States-Israel Free Trade Area (IL); and Andean Trade Preference Act (J or J*).

[2] Uruguay Round bound rates of duty are published by the office of the U.S. Trade Representative, *Results of the Uruguay Round Market Access Negotiations, GATT Schedule XX, United States of America, Vol. 1, General Notes, Agriculture*, Washington, DC.; U.S. Government Printing Office, Apr. 1994.

[3] Not available.

[4] Export figure is for schedule B number 1209.22.40.96.

[5] Export figure is for schedule B number 1209.23.00.40.

[6] Export figure is for schedule B number 1209.29.00.85

[7] Export figure is for schedule B number 1209.91.90.

Source: U.S. exports and imports compiled from data of the U.S. Department of Commerce. Harmonized Tariff Schedule of the United States (1994), with Supplements 1 and 2.

most U.S. seed imports entered duty-free or were subject to very low specific rates of duty, not exceeding 3.3 cents per kilogram. Major exceptions are sweet corn seeds for sowing, with a 13-percent ad valorem rate in 1994 that declines to 8.3 percent under the provisions of the URA; seed wheat other than durum with a 6.3-percent ad valorem rate that declines to 2.8 percent under the URA; and cauliflower seeds at 13.2 cents per kilogram that declines to 5.9 cents per kilogram under the URA. Further, many U.S. seed imports enter duty free under the Generalized System of Preference, the Caribbean Basin Economic Recovery Act, the U.S.-Canada Free Trade Agreement, or the Andean Trade Preference Act (appendix B). Under the U.S.-Canada Free Trade Agreement, other seeds enter the United States at sharply reduced rates. The trade weighted average rates of duty for U.S. seed imports for 1989-93 are:

| Year | Average trade-weighted rate of duty |
|---|---|
| | *Percent ad valorem* |
| 1989 | 0.25 |
| 1990 | 0.34 |
| 1991 | 0.41 |
| 1992 | 0.20 |
| 1993 | 0.26 |

*NAFTA.* The North American Free-Trade Agreement (NAFTA), as implemented by the NAFTA Implementation Act (Public Law 103-182, approved December 8, 1993), provided for the elimination of U.S. duties (from CA or MX), effective January 1, 1994, for the following seeds for sowing covered in this summary:[100]

Mushroom spawn
Sweet corn seeds (only MX)
Dried leguminous vegetable seeds
Seed wheat (other than durum) (only MX)
Grain sorghum
Seeds of forage plants
Flower seeds
Vegetable seeds (only MX)
Trees, shrubs, and miscellaneous seeds (only MX)

The NAFTA provides for the phaseout of U.S. duties over a 10-year period beginning January 1, 1994, on durum wheat seed imports from Mexico.[101]

*Uruguay Round.* United States and foreign duties are scheduled to be further reduced on account of the recently enacted legislation in the United States and other major trading countries implementing the GATT URA. The newly enacted U.S. tariff reductions for the commodities covered by this summary are shown in table 2.

### Nontariff Measures

Until recently, the Federal Seed Act[102] required the staining of a percentage of certain seeds, e.g., alfalfa, for purposes of identification as to use and origin. However, the Uruguay Round has eliminated this requirement.[103] In accordance with the President's message, the change "shall take effect on the date of entry into force of the WTO Agreement with respect to the United States."[104] Corn seed imports from various parts of Asia and Oceania are subject to plant quarantine regulations (7 CFR 319.24).

## FOREIGN TRADE MEASURES

### Tariff Measures

The European Union, Mexico, and Japan are major seed customers. Few nations have prohibitive import tariffs for commercial seed. The European Union (EU) is a principal trading partner with the United States in seeds, and accounted for over 20 percent of all U.S. planting seed imports in marketing year 1992/93.[105] The EU conventional rates are those for signatory nations to the GATT. Except for beet seed—beet sugar is a major European product—the relatively low conventional rates are typical of those faced by U.S. seeds exports, and are in the range of 4 to 7 percent ad valorem.

Under NAFTA provisions that became effective for the United States and Mexico on January 1, 1994, Mexico eliminated its duties on imports of the following seeds from the United States (as of January 1, 1994):

Mushroom spawn
Sweet corn seed
Dried leguminous vegetable seeds
Grain sorghum seed
Seeds of forage plants

[100] Unless they already are duty-free, the commodities provided for in these groups have a "staging category" of "A," for example, according to Annex 302.2 of the NAFTA: "duties on goods provided for in the items in staging category A in a Party's schedule shall be eliminated entirely and such goods shall be duty-free, effective Jan. 1, 1994."

[101] Duties on imports of durum seed from Canada were already reduced under the provisions of the U.S.-Canada Free-Trade Agreement.

[102] Federal Seed Act of 1939, *op. cit.*

[103] *Message from the President*, transmitting the URA, texts of agreements implementing bill, statement of administrative action and required supporting statements, 103d Congress, 2d Session, House Document 103-316, Vol. 1, Sept. 27, 1994, section dealing with Subtitle C -Standards, the Federal Seed Act (7 U.S.C. § 1551 et seq.).

[104] The WTO is the World Trade Organization. The general effective date is specified in Subtitle D of the President's message, *op. cit.*

[105] USDA, Foreign Agricultural Service, *U.S. Planting Seed Trade*, Circular Series (FFVS 3-93), Oct. 1993.

Flower seeds
Vegetable seeds
Trees, shrubs, and miscellaneous seeds

## Nontariff Measures

The most important nontariff barriers faced by the U.S. seed industry today are phytosanitary measures,[106] especially in middle income and developing nations. These requirements in many instances are more restrictive than those imposed by the United States on seed imports. For instance, according to the ASTA and the Foreign Agricultural Service of the U.S. Department of Agriculture (USDA-FAS), over the last few years, Mexico went from imposing virtually no phytosanitary requirements to requiring that exports to Mexico of some 20 U.S. vegetable seeds be certified free of 60 diseases. Another example cited by the ASTA and USDA-FAS is Turkey, which requires that virtually all imported seeds be certified as free of virtually every seed pathogen found in the European Plant Protection Organization (EPPO),[107] instead of selecting and applying those diseases pertinent to its geographical area.

The U.S. seed industry believes that China imposes excessive phytosanitary requirements and that such requirements act as a nontariff barrier to seed imports. For example, according to ASTA, China requires that imported corn seed be certified as free of Stewart's wilt, notwithstanding the fact that U.S. studies show that this wilt is not economically harmful or statistically significant in its seed pathogen transmission rate. The ASTA believes that, especially among middle- and low-income nations lacking the technical expertise to test for pathogens, many of these phytosanitary regulations are being applied as nontariff barriers, in lieu of tariffs.[108]

Official government bodies with jurisdiction over quality, health and performance standards may also effectively act to set up seed trade barriers.[109] For example, the Canadian Grain Commission licenses the use of wheat seed varieties that may be used in Canada, in order to maintain the uniform quality and desirable milling characteristics of Canadian wheat. In the past, Canada has denied permission for Canadian farmers to use the U.S.-developed Grandin wheat variety because of allegedly questionable milling characteristics.[110]

# U.S. MARKET

## Production

Data on U.S. production and stocks of seeds, previously compiled by the U.S. Department of Agriculture, are no longer available. The 1982 *U.S. Census of Agriculture* indicates that California, Idaho, and Washington accounted for close to three-quarters, by volume, of all seeds produced in the United States.[111]

The United States has a comparative advantage in major phases of seed development. Such comparative advantage comes from plentiful land areas, biotechnology expertise, favorable climate, and a strong cooperation between private industry and the government-funded activities. Seed production requires a great deal of land outside of major producing areas.[112] Fields must be isolated to prevent cross-pollination.[113] Furthermore, the production of seeds of many different varieties requires access to varied soils and climate conditions. The United States has this land, soil, and climatic variety.

## Imports

During 1989-93, U.S. imports of seeds rose by 23 percent from $169 million to $206 million (table 3). The principal supplier of seeds to the United States has been Canada. In 1993, the value of U.S. imports of seeds from Canada was $55 million, up 20 percent from $46 million in 1989 (table 4). Chile is the second-most-important source of U.S. seed imports. In 1989, the United States imported $22 million of seeds from Chile; in 1993 this sum rose by 18 percent to $26 million. Besides being a major horticultural nation, the Netherlands is one of the main trade gateways of the EU. In 1989, the United States imported $15 million of seeds from the Netherlands; in 1993 this sum rose by 53 percent to $23 million of seeds imports. Japan exports many seeds to the United States, both for consumption and for reproduction or multiplication. In 1989, U.S. imports of seeds from Japan were valued at $12 million, rising by 42 percent to $17 million by 1993.

---

[106] According to the USITC staff conversation with ASTA official, Aug. 12, 1994.

[107] The EPPO is a European regional organization akin to the North American Plant Health Organization (NAPHO).

[108] USITC staff conversation with Mark Condon of ASTA, Sept. 6, 1994; and USITC staff conversation with Logol Coonrod (USDA-FAS), Sept. 9, 1994.

[109] USITC, *Wheat, Wheat Flour, and Semolina*, inv. no. 22-54, USITC publication 2794, July 1994; See information obtained in the investigation, pg. II-54.

[110] Ibid..

[111] Since production data are no longer available, neither apparent consumption (defined as "production-exports+imports") nor import penetration (defined as the ratio of imports to domestic consumption) can be calculated..

[112] Nevertheless, the production of marketable quantities of a single seed type may require very little land. For example, thousands of tobacco seeds are produced by one plant. Thus, although the quantity or value of seeds may not be great, the impact worldwide of seed production may be great.

[113] *Seeds, The Yearbook of Agriculture*, 1961.

**Table 3**
**Seeds: U.S. exports of domestic merchandise, imports for consumption, unit values, and trade balance, 1989-93**

| Year | Exports | Imports | Trade balance |
|---|---|---|---|
| | Quantity (*metric tons*) | | |
| 1989 | 376,630 | 81,706 | 294,925 |
| 1990 | 432,019 | 73,393 | 358,626 |
| 1991 | 451,924 | 88,739 | 363,186 |
| 1992 | 614,276 | 119,829 | 494,448 |
| 1993 | 423,525 | 119,012 | 304,514 |
| | Value (*1,000 dollars*) | | |
| 1989 | 447,840 | 168,933 | 278,908 |
| 1990 | 532,491 | 145,600 | 386,891 |
| 1991 | 620,172 | 163,028 | 457,143 |
| 1992 | 629,687 | 204,407 | 425,280 |
| 1993 | 579,841 | 205,705 | 374,136 |
| | Unit value (*per kg.*) | | |
| 1989 | $1.19 | $2.07 | (1) |
| 1990 | 1.23 | 1.98 | (1) |
| 1991 | 1.37 | 1.84 | (1) |
| 1992 | 1.03 | 1.71 | (1) |
| 1993 | 1.37 | 1.30 | (1) |

[1] Not meaningful.

Note.—Unit values calculated from the unrounded figures.

Source: Compiled from official statistics of the U.S. Department of Commerce.

**Table 4**
**Seeds: U.S. imports, by principal sources, 1989 and 1993**

| Source | 1989 | 1993 | Average annual change |
|---|---|---|---|
| | *1,000 dollars* | | *Percent* |
| Canada | 45,605 | 54,689 | 5 |
| Chile | 22,433 | 25,969 | 4 |
| Netherlands | 14,993 | 23,464 | 12 |
| Japan | 11,726 | 16,994 | 10 |
| China | 6,728 | 11,742 | 15 |
| Mexico | 5,080 | 8,451 | 14 |
| Guatemala | 3,884 | 6,626 | 14 |
| New Zealand | 4,142 | 6,355 | 11 |
| Argentina | 6,772 | 6,071 | -3 |
| Subtotal | 121,364 | 160,359 | 7 |
| Total imports | 168,933 | 205,705 | 5 |
| Subtotal as percent of total | 69 | 78 | - |

Source: Official statistics of the U.S. Department of Commerce.

Corn and fescue seeds stand out for the quantity imported.[114] The United States imported close to $20 million of corn seed (*HTS* subheading 1005.10) from Chile in 1992, up from $13 million in 1989. In 1992 the United States imported close to $16 million of fescue seed (*HTS* subheading 1209.23) from Canada, up from $8 million in 1990. In 1993, U.S. imports of fescue seed from Canada declined to $12 million. The principal sources of the principal kinds of U.S. imports of seeds in 1989 and 1993 are Canada, Chile, the Netherlands, Japan, China, Mexico, Guatemala, New Zealand, and Argentina (based on 1993 data; table 5).[115]

[114] Table 5 shows the principal sources for U.S. seeds imports, for 1989 and 1993.

[115] Compiled from official statistics of the U.S. Department of Commerce.

**Table 5**
**Seeds: U.S. imports by seed types and by principal sources, 1989 and 1993**

| Seed type | Principal source in 1993 | HTS number | Imports 1989 | Imports 1993 |
|---|---|---|---|---|
| | | | 1,000 dollars | |
| Mushroom spawn | France, Netherlands | 0602.91 | 335 | 332 |
| Sweet corn | Chile | 0712.90[1] | 24 | 1,681 |
| Peas & beans | Canada, China, Chile, Thailand | 0713.10[1] to 0713.90[1] | 5,388 | 18,060 |
| Wheat | Canada | 1001.10[1] to 1001.90[1] | 517 | 1,595 |
| Oats | Canada | 1004.00[1] | ([2]) | 263 |
| Corn | Canada, Chile, Argentina, Romania | 1005.10 | 36,913 | 29,304 |
| Grain sorghum | Argentina | 1007.00[1] | 46 | 81 |
| Sugar beet | Sweden, Belgium | 1209.11 to 1209.19 | 1,234 | 406 |
| Alfalfa | Canada | 1209.21 | 6,596 | 4,354 |
| Clover | New Zealand, Canada, Australia | 1209.22 | 9,319 | 7,761 |
| Fescue | Canada, New Zealand | 1209.23 | 14,668 | 14,930 |
| Kentucky blue grass | Denmark, Netherlands | 1209.24 | 2,332 | 894 |
| Rye grass | New Zealand, Netherlands | 1209.25 | 3,993 | 7,222 |
| Timothy grass | Canada | 1209.26 | 2,898 | 2,637 |
| Seeds of forage plants | Canada, Denmark, New Zealand | 1209.29 | 3,772 | 6,763 |
| Flowers | Netherlands, Guatemala | 1209.30 | 24,448 | 31,772 |
| Vegetables, all[3] | Chile, Netherlands, China, Japan, Mexico, Thailand, India, Taiwan, Israel | 1209.91 | 39,308 | 53,473 |
| Trees, shrubs, fruits, & spores | Japan, Chile, Mexico, Thailand, China | 1209.99 | 17,142 | 24,174 |
| World Total | Canada, Chile, Netherlands, Japan, China, Mexico, Guatemala, New Zealand, Argentina | | 168,933 | 205,705 |

[1] Only a part of these HTS numbers are seeds for sowing.
[2] Not available.
[3] In 1989, 45 percent of vegetable seed imports were accounted for by tomato seeds, down to 30 percent in 1993.
Note.—May not add to total owing to rounding and aggregation.
Source: Official statistics of the U.S. Department of Commerce.

# FOREIGN MARKETS

## Foreign Market Profile

The two largest markets for seeds are the three NAFTA nations and the European Union (EU). Although other areas, such as lesser developed nations, may produce large amounts of seeds, these often tend to be for consumption at home, and they do not enter international marketing channels. Corn seed for sowing composed about 29 percent of U.S. seed exports in 1993, primarily to Italy, Mexico, and the Ukraine. About 22 percent of U.S. seed exports in the same year were vegetable seeds shipped to Mexico, Canada, Japan, the EU, and the United Arab Emirates.

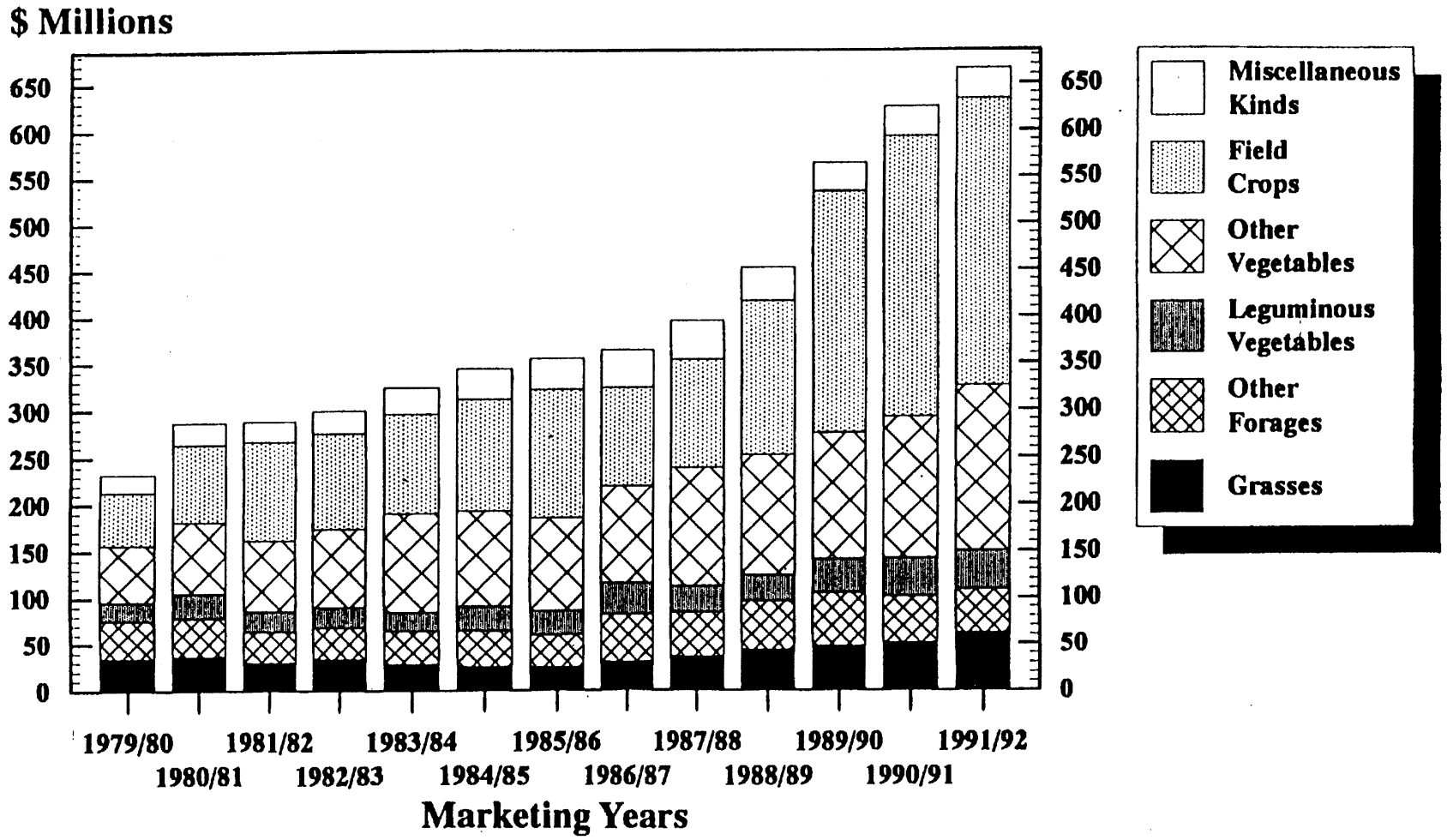
The exports to Japan and the EU were in part the result of seeds that were sent to the United States for multiplication. Seeds need to be segregated from other plants/varieties to avoid cross-pollination by insects or the wind in order to maintain varietal purity so that the seeds may be properly certified by government agencies.

## U.S. Exports

Field and vegetable crop seeds are the dominant export categories (figure 3). Between 1989 and 1993, U.S. exports of all the seeds covered in this summary rose from 377 million kg, valued at $448 million, to 424 million kg, valued at $580 million (Table 7). The principal markets for U.S. seed exports are Mexico (accounting for $113 million of U.S. seed exports in 1993), Canada ($73 million), Italy ($52 million), and Japan ($45 million); these markets are also major suppliers of seeds to the United States, underlining the international two-way nature of the seed industry.

**Figure 3**
**U.S. planting seed exports by kind**

July-June 1979/80 through 1991/92




Source: Census Bureau/USDOC TC&SD/C&MP/FAS/USDA

According to USDA data[116], the more important regional markets (as differing from national markets) for U.S. seed exports are North America (accounting for over $190 million in U.S. seed exports in marketing year 1991/92), the EU (accounting for $240 million), and the Middle East (accounting for $82 million) (table 6).

U.S. seed exports by seed type and principal destination are shown in table 7. Corn seed is the largest seed export category, accounting for 29 percent of the value of all seed exports in 1993. The second-largest category is vegetable seeds, accounting for 22 percent of 1993 seed exports.

[116] USDA data for seeds are provided in June-July marketing years, whereas Department of Commerce data (Census) are provided on an annual basis. USDA data tend to be cross-checked with data provided by the Agricultural attaches throughout the world, and market reporter data provided by the Agricultural Marketing Service. Data are provided for 1991/92 because 1992/93 data provided are not comparable.

# U.S. TRADE BALANCE

Between 1989 and 1993, the U.S. trade balance in seeds has been consistently positive, fluctuating by 64 percent from a low of $279 million in 1989 to a high of $457 million in 1991 (table 8). The U.S. seed trade surplus was $374 million in 1993 (table 3). During the same period, exports of seeds fluctuated by 41 percent from $448 million in 1989 to $630 million in 1992, although imports fluctuated by 42 percent, rising from $146 million in 1990 to $206 million in 1993. Figure 4 provides an illustration of the positive U.S. balance of trade in planting seeds.

The rising trend in U.S. seed exports, the heavy preponderance of vegetable seed exports (for example, food seeds), the growing world population, the rising world income, better diets, and the comparative advantage the United States has in seed production, all point to a continued positive trade balance in seeds.

**Table 6**
**Seeds: U.S. exports, by destination, July-June 1988/89 and 1991/92**

| Destination | Quantity | | Value | |
|---|---|---|---|---|
| | 1988/89 | 1991/92[1] | 1988/89 | 1991/92[1] |
| | *1,000 Kilograms* | | *1,000 dollars* | |
| North America | 143,101 | 287,364 | 138,720 | 190,175 |
| Caribbean | 1,714 | 1,581 | 4,144 | 3,409 |
| Central America | 2,068 | 2,839 | 5,681 | 7,651 |
| South America | 11,642 | 14,478 | 36,670 | 30,516 |
| European Union | 88,252 | 152,065 | 129,513 | 239,973 |
| Other Western Europe | 4,482 | 3,603 | 6,108 | 9,759 |
| FSU & Eastern Europe[2] | 735 | 51,038 | 4,764 | 10,091 |
| Middle East | 35,642 | 166,337 | 39,911 | 81,588 |
| North Africa | 1,811 | 7,226 | 5,651 | 8,353 |
| Central Africa | 925 | 246 | 1,862 | 1,703 |
| South Africa | 2,094 | 2,416 | 5,511 | 6,433 |
| South Asia | 1,231 | 1,164 | 1,428 | 2,074 |
| Southeast Asia | 771 | 2,930 | 2,301 | 4,259 |
| Other Asia | 29,361 | 32,448 | 60,611 | 59,579 |
| Oceania | 5,114 | 6,645 | 8,604 | 9,658 |
| Total World[3] | 328,943 | 732,380 | 451,479 | 665,221 |

[1] Data provided for 1992/93 are not comparable to prior years.
[2] FSU = Former Soviet Union.
[3] May not add due to rounding.

Source: U.S. Department of Agriculture, Foreign Agriculture Service, Circular Series, *U.S. Seed Exports* (FFV 3-89, 11/89 and FFV 6-92, 10/92; table 2).

**Table 7**
**Seeds: U.S. exports, by types and principal markets, 1989 and 1993**

| Seed | Schedule B number | 1989 | 1993 | Principal Market in 1993 |
|---|---|---|---|---|
| | | *1,000 dollars* | | |
| Mushroom spawn | 0602.91 | 1,161 | 12,927 | Canada, Netherlands[1], U.K.[2] |
| Sweet corn | 0712.90.80.50[3] | 19,626 | 25,175 | Italy, Canada, France, Japan |
| Peas | 0713.10.10[3] | 15,009 | 13,344 | Canada, France, U.K., Spain |
| Chickpeas | 0713.20.10[3] | 453 | 203 | Japan, Netherlands |
| Beans | 0713.31.10[3] | 6,322 | 3,178 | Netherlands, Canada |
| Small red beans | 0713.32.10[3] | 66 | 178 | Japan, Australia |
| Kidney beans | 0713.33.10[3] | 3,968 | 13,756 | Canada, France, Italy |
| Beans, nesoi | 0713.39.10[3] | 3,878 | 1,889 | Netherlands, Mexico, Canada |
| Lentils | 0713.40.10[3] | 1,788 | 253 | Barbados, Peru |
| Broad beans | 0713.50.10[3] | 18 | 239 | Mexico, Canada, Jordan |
| Dried leguminous vegetables | 0713.90.10[3] | 293 | 2,593 | Canada, Argentina |
| Wheat and meslin | 1001.90.10[3] | 47,622 | 5,799 | Saudi Arabia, Mexico, Finland |
| Corn | 1005.10 | 68,538 | 167,619 | Italy, Mexico, Ukraine |
| Grain sorghum | 1007.00.00.20[3] | 55,034 | 34,494 | Mexico, Paraguay, France |
| Sugar beet | 1209.11 | 836 | 3,457 | Canada, Brazil |
| Other beet | 1209.19 | 2,218 | 2,688 | Netherlands, Japan, Kenya |
| Alfalfa | 1209.21 | 28,202 | 34,418 | Argentina, Canada, Mexico, Saudi Arabia |
| Clover | 1209.22 | 4,722 | 5,827 | Italy, Canada, Japan |
| Fescue | 1209.23 | 11,241 | 9,232 | Japan, Canada |
| Kentucky blue grass | 1209.24 | 6,621 | 6,750 | Canada, Japan |
| Rye grass | 1209.25 | 3,414 | 9,335 | Japan, Canada |
| Timothy grass | 1209.26 | 2,028 | 1,729 | Japan, Netherlands |
| Bent grass | 1209.29.00.20[3] | 9,579 | 5,165 | Canada, U.K. |
| Orchard grass | 1209.29.00.40[3] | 2,139 | 2,527 | Japan, Canada |
| Sudan grass | 1209.29.00.60[3] | 3,585 | 1,540 | Saudi Arabia, France, Japan |
| Forage plants, nesoi | 1209.29 | 19,488 | 39,525 | Canada, U.K., Italy, Germany, Japan, Netherlands |
| Herbaceous plants, esp. flowers | 1209.30 | 10,978 | 19,380 | Canada, U.K., Italy, Germany, Japan |
| Vegetables | 1209.91 | 89,768 | 126,136 | Mexico, Canada, Japan, EU[4], UAR[5] |
| Seeds, fruits, and spores | 1209.99 | 24,367 | 30,486 | Mexico, Netherlands, Algeria, Costa Rica, Canada, Japan, Italy |
| Total seeds | | 447,840 | 579,841 | Mexico, Canada, Italy, Japan, France, Netherlands, Ukraine, Argentina, Saudi Arabia |

[1] The Netherlands is a major import point for destinations within the European Union.
[2] U.K. = United Kingdom.
[3] Statistics include part related to seeds.
[4] EU = European Union (was called the European Community, or EC).
[5] UAR = United Arab Emirates.

Note.—May not add to total owing to rounding and aggregations.
Source: Compiled from official statistics of the U.S. Department of Commerce.

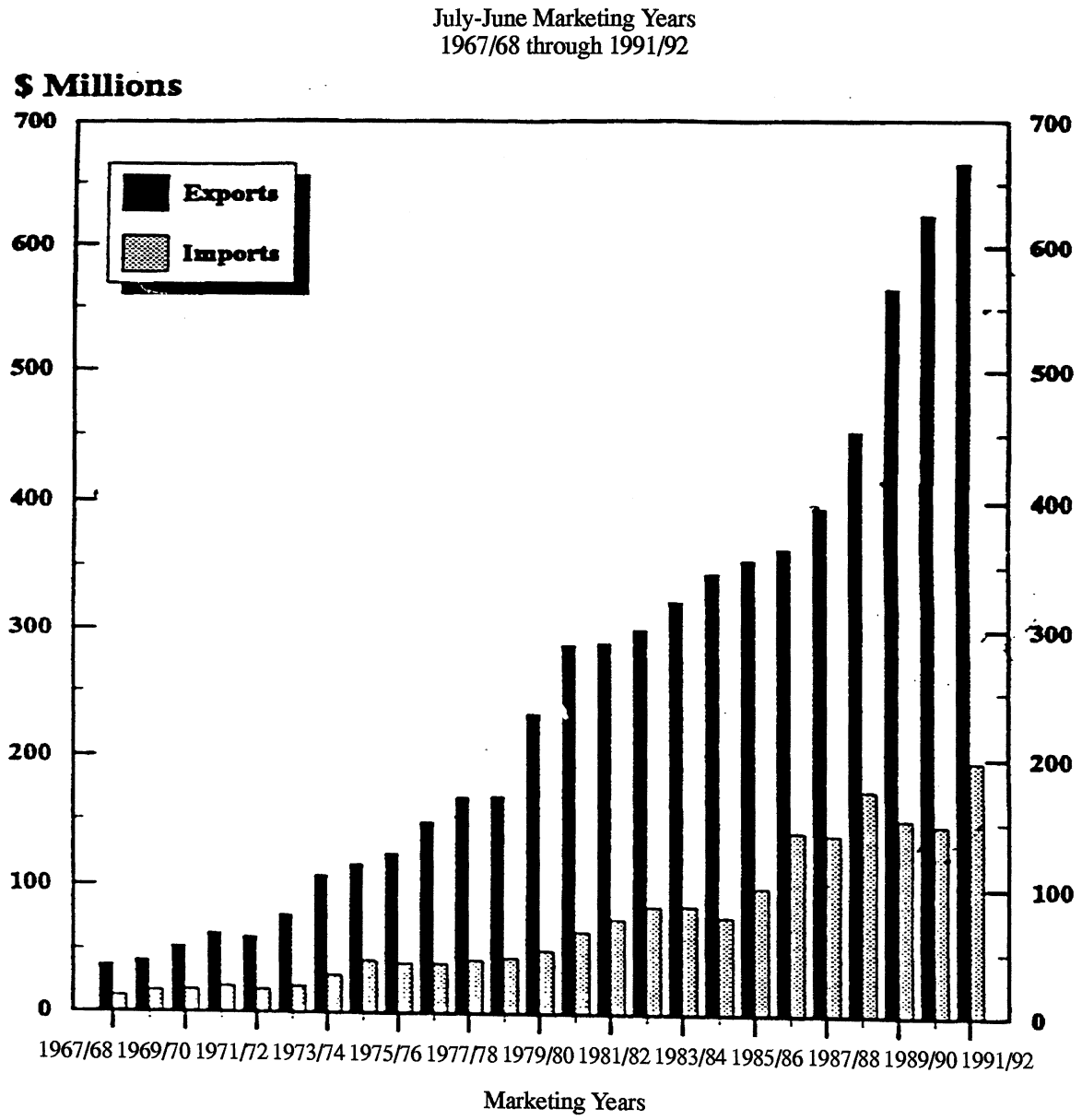
**U.S. trade balance, 1989-93**

*(1,000 dollars)*

| | Imports | Exports | Trade balance |
|---|---|---|---|
| 1989 | 168,933 | 447,840 | 278,908 |
| 1990 | 145,600 | 532,491 | 386,891 |
| 1991 | 163,028 | 620,172 | 457,143 |
| 1992 | 204,407 | 629,687 | 425,280 |
| 1993 | 205,705 | 579,841 | 374,136 |

Source: Compiled from official statistics of the U.S. Department of Commerce.

**Figure 4**
**U.S. Planting seed balance of trade**




Source: Census Bureau/USDOC TCSD/CMP/FAS/USDA

# APPENDIX A
# STATISTICAL TABLES

**Table A-1**
**Mushroom spawn (HTS 0602.91.00): U.S. exports, imports, and trade balance, 1989-93**

| Year | Exports | Imports | Trade balance |
|---|---|---|---|
| | | **Quantity** (*metric tons*) | |
| 1989 | 781 | 126 | 655 |
| 1990 | 2,402 | 245 | 2,157 |
| 1991 | 2,713 | 463 | 2,250 |
| 1992 | 3,964 | 363 | 3,601 |
| 1993 | 5,535 | 131 | 5,404 |
| | | **Value** (*1,000 dollars*) | |
| 1989 | 1,161 | 335 | 826 |
| 1990 | 4,957 | 684 | 4,273 |
| 1991 | 7,013 | 1,058 | 5,955 |
| 1992 | 8,735 | 764 | 7,970 |
| 1993 | 12,927 | 332 | 12,595 |
| | | **Unit value** (*per kg*) | |
| 1989 | $1.49 | $2.65 | - |
| 1990 | 2.06 | 2.79 | - |
| 1991 | 2.58 | 2.29 | - |
| 1992 | 2.20 | 2.11 | - |
| 1993 | 2.34 | 2.54 | - |

Note.—Unit values calculated from unrounded figures.

Source: Compiled from official statistics of the U.S. Department of Commerce.

**Table A-2**
**Sweet corn seeds of a kind used for sowing (HTS 0712.90.80.50): U.S. exports, imports, and trade balance, 1989-93**

| Year | Exports | Imports | Trade balance |
|---|---|---|---|
| | | **Quantity** (*1,000*) | |
| 1989 | 10,076 | 10 | 10,066 |
| 1990 | 7,054 | 41 | 7,013 |
| 1991 | 15,658 | 204 | 15,455 |
| 1992 | 12,140 | 129 | 12,011 |
| 1993 | 10,701 | 386 | 10,315 |
| | | **Value** (*1,000 dollars*) | |
| 1989 | 19,626 | 24 | 19,602 |
| 1990 | 19,991 | 121 | 19,870 |
| 1991 | 30,493 | 622 | 29,871 |
| 1992 | 24,028 | 338 | 23,690 |
| 1993 | 25,175 | 1,681 | 23,493 |
| | | **Unit value** (*per kg*) | |
| 1989 | $1.95 | $2.37 | - |
| 1990 | 2.83 | 2.97 | - |
| 1991 | 1.95 | 3.05 | - |
| 1992 | 1.98 | 2.62 | - |
| 1993 | 2.35 | 4.35 | - |

Note.—Unit values calculated from unrounded figures.

Source: Compiled from official statistics of the U.S. Department of Commerce.

**Table A-3**
**Peas, seeds of a kind used for sowing (HTS 0713.10.10): U.S. exports, imports, and trade balance, 1989-93**

| Year | Exports | Imports | Trade balance |
|---|---|---|---|
| | | **Quantity** (*1,000 kg*) | |
| 1989 | 23,070 | 2,377 | 20,693 |
| 1990 | 23,807 | 4,373 | 19,435 |
| 1991 | 19,722 | 9,956 | 9,766 |
| 1992 | 17,734 | 11,345 | 6,389 |
| 1993 | 18,137 | 15,768 | 2,368 |
| | | **Value** (*1,000 dollars*) | |
| 1989 | 15,009 | 1,585 | 13,425 |
| 1990 | 15,752 | 1,486 | 14,266 |
| 1991 | 16,308 | 3,439 | 12,869 |
| 1992 | 12,637 | 3,666 | 8,971 |
| 1993 | 13,344 | 5,448 | 7,896 |
| | | **Unit value** (*per kg*) | |
| 1989 | $0.65 | $0.67 | - |
| 1990 | .66 | .34 | - |
| 1991 | .83 | .35 | - |
| 1992 | .71 | .32 | - |
| 1993 | .74 | .35 | - |

Note.—Unit values calculated from unrounded figures.

Source: Compiled from official statistics of the U.S. Department of Commerce.

**Table A-4**
**Chickpeas, seeds of a kind used for sowing (HTS 0713.20.10): U.S. exports, imports, and trade balance, 1989-93**

| Year | Exports | Imports | Trade balance |
|---|---|---|---|
| | | **Quantity** (*1,000 kg*) | |
| 1989 | 1,309 | 133 | 1,176 |
| 1990 | 316 | 63 | 252 |
| 1991 | 459 | 322 | 136 |
| 1992 | 654 | 818 | (164) |
| 1993 | 290 | 90 | 200 |
| | | **Value** (*1,000 dollars*) | |
| 1989 | 453 | 93 | 361 |
| 1990 | 201 | 47 | 154 |
| 1991 | 325 | 177 | 148 |
| 1992 | 583 | 475 | 108 |
| 1993 | 203 | 80 | 123 |
| | | **Unit value** (*per kg*) | |
| 1989 | $0.35 | $0.70 | - |
| 1990 | .64 | .74 | - |
| 1991 | .71 | .55 | - |
| 1992 | .89 | .58 | - |
| 1993 | .70 | .89 | - |

Note.—Unit values calculated from unrounded figures.

Source: Compiled from official statistics of the U.S. Department of Commerce.

**Table A-5**
**Mung beans, seeds of a kind used for sowing (HTS 0713.31.10): U.S. exports, imports, and trade balance, 1989-93**

| Year | Exports | Imports | Trade balance |
|---|---|---|---|
| | **Quantity** (*1,000 kg*) | | |
| 1989 | 5,413 | 1,089 | 4,324 |
| 1990 | 6,632 | 313 | 6,319 |
| 1991 | 3,688 | 8,165 | (1,477) |
| 1992 | 3,253 | 8,015 | (4,762) |
| 1993 | 2,611 | 6,274 | (3,663) |
| | **Value** (*1,000 dollars*) | | |
| 1989 | 6,322 | 590 | 5,733 |
| 1990 | 6,337 | 261 | 6,076 |
| 1991 | 4,710 | 2,485 | 2,225 |
| 1992 | 3,910 | 3,851 | 59 |
| 1993 | 3,178 | 3,524 | (347) |
| | **Unit value** (*per kg*) | | |
| 1989 | $1.17 | $0.54 | - |
| 1990 | 0.96 | 0.83 | - |
| 1991 | 1.28 | 0.48 | - |
| 1992 | 1.20 | 0.48 | - |
| 1993 | 1.22 | 0.56 | - |

Note.—Unit values calculated from unrounded figures.

Source: Compiled from official statistics of the U.S. Department of Commerce.

**Table A-6**
**Small red beans (adzuki), seeds of a kind used for sowing (HTS 0713.32.10): U.S. exports, imports, and trade balance, 1989-93**

| Year | Exports | Imports | Trade balance |
|---|---|---|---|
| | **Quantity** (*1,000 kg*) | | |
| 1989 | 89 | 9 | 80 |
| 1990 | 66 | 3 | 63 |
| 1991 | 1,180 | 125 | 1,055 |
| 1992 | 1,881 | 112 | 1,770 |
| 1993 | 138 | 142 | (5) |
| | **Value** (*1,000 dollars*) | | |
| 1989 | 66 | 20 | 46 |
| 1990 | 67 | 5 | 62 |
| 1991 | 1,097 | 78 | 1,019 |
| 1992 | 1,124 | 64 | 1,060 |
| 1993 | 178 | 96 | 82 |
| | **Unit value** (*per kg*) | | |
| 1989 | $0.74 | $2.35 | - |
| 1990 | 1.00 | 1.37 | - |
| 1991 | .93 | .62 | - |
| 1992 | .60 | .58 | - |
| 1993 | 1.29 | .67 | - |

Note.—Unit values calculated from unrounded figures.

Source: Compiled from official statistics of the U.S. Department of Commerce.

**Table A-7**
**Kidney and white pea beans, seeds of a kind used for sowing (HTS 0713.33.10): U.S. exports, imports, and trade balance, 1989-93**

| Year | Exports | Imports | Trade balance |
|---|---|---|---|
| | | **Quantity** (*1,000 kg*) | |
| 1989 | 4,018 | 365 | 3,653 |
| 1990 | 6,100 | 1,105 | 4,995 |
| 1991 | 10,186 | 1,685 | 8,501 |
| 1992 | 12,635 | 1,136 | 11,499 |
| 1993 | 11,972 | 2,076 | 9,895 |
| | | **Value** (*1,000 dollars*) | |
| 1989 | 3,968 | 361 | 3,606 |
| 1990 | 6,895 | 1,104 | 5,791 |
| 1991 | 14,927 | 928 | 13,998 |
| 1992 | 16,714 | 720 | 15,993 |
| 1993 | 13,756 | 1,177 | 12,578 |
| | | **Unit value** (*per kg*) | |
| 1989 | $0.99 | $0.99 | - |
| 1990 | 1.13 | 1.00 | - |
| 1991 | 1.47 | .55 | - |
| 1992 | 1.32 | .63 | - |
| 1993 | 1.15 | .57 | - |

Note.—Unit values calculated from unrounded figures.

Source: Compiled from official statistics of the U.S. Department of Commerce.

**Table A-8**
**Beans, nesoi, seeds of a kind used for sowing (HTS 0713.39.10): U.S. exports, imports, and trade balance, 1989-93**

| Year | Exports | Imports | Trade balance |
|---|---|---|---|
| | | **Quantity** (*1,000 kg*) | |
| 1989 | 3,375 | 847 | 2,528 |
| 1990 | 3,589 | 405 | 3,184 |
| 1991 | 3,245 | 4,444 | (1,199) |
| 1992 | 2,031 | 10,422 | (8,391) |
| 1993 | 1,815 | 11,088 | (9,273) |
| | | **Value** (*1,000 dollars*) | |
| 1989 | 3,878 | 790 | 3,088 |
| 1990 | 4,697 | 418 | 4,279 |
| 1991 | 3,979 | 1,741 | 2,238 |
| 1992 | 2,065 | 3,804 | (1,739) |
| 1993 | 1,889 | 5,992 | (4,103) |
| | | **Unit value** (*per kg*) | |
| 1989 | $1.15 | $0.93 | - |
| 1990 | 1.31 | 1.03 | - |
| 1991 | 1.23 | .39 | - |
| 1992 | 1.02 | .36 | - |
| 1993 | 1.04 | .54 | - |

Note.—Unit values calculated from unrounded figures.

Source: Compiled from official statistics of the U.S. Department of Commerce.

**Table A-9**
**Lentils, seeds of a kind used for sowing (HTS 0713.40.10): U.S. exports, imports, and trade balance, 1989-93**

| Year | Exports | Imports | Trade balance |
|---|---|---|---|
| | | **Quantity** (*1,000 kg*) | |
| 1989 | 3,500 | 50 | 3,450 |
| 1990 | 2,909 | 196 | 2,714 |
| 1991 | 914 | 3,681 | (2,767) |
| 1992 | 1,121 | 2,775 | (1,653) |
| 1993 | 367 | 2,297 | (1,930) |
| | | **Value** (*1,000 dollars*) | |
| 1989 | 1,788 | 34 | 1,754 |
| 1990 | 1,531 | 110 | 1,420 |
| 1991 | 750 | 2,085 | (1,335) |
| 1992 | 628 | 1,145 | (517) |
| 1993 | 253 | 1,085 | (832) |
| | | **Unit value** (*per kg*) | |
| 1989 | $0.51 | $0.68 | - |
| 1990 | .53 | .57 | - |
| 1991 | .82 | .57 | - |
| 1992 | .56 | .41 | - |
| 1993 | .69 | .47 | - |

Note.—Unit values calculated from unrounded figures.

Source: Compiled from official statistics of the U.S. Department of Commerce.

**Table A-10**
**Broad beans and horse beans, seeds of a kind used for sowing (HTS 0713.50.10): U.S. exports, imports, and trade balance, 1989-93**

| Year | Exports | Imports | Trade balance |
|---|---|---|---|
| | | **Quantity** (*1,000 kg*) | |
| 1989 | 9 | 55 | (46) |
| 1990 | 5 | 152 | (147) |
| 1991 | 283 | 622 | (339) |
| 1992 | 52 | 804 | (752) |
| 1993 | 404 | 949 | (546) |
| | | **Value** (*1,000 dollars*) | |
| 1989 | 18 | 24 | (5) |
| 1990 | 5 | 45 | (40) |
| 1991 | 310 | 190 | 119 |
| 1992 | 29 | 254 | (225) |
| 1993 | 239 | 300 | (62) |
| | | **Unit value** (*per kg*) | |
| 1989 | $1.95 | $0.42 | - |
| 1990 | .98 | .30 | - |
| 1991 | 1.09 | .31 | - |
| 1992 | .55 | .32 | - |
| 1993 | .59 | .32 | - |

Note.Unit values calculated from unrounded figures.

Source: Compiled from official statistics of the U.S. Department of Commerce.

**Table A-11**
**Dried leguminous vegetables, nesoi, seeds of a kind used for sowing (HTS 0713.90.10): U.S. exports, imports, and trade balance, 1989-93**

| Year | Exports | Imports | Trade balance |
|---|---|---|---|
| | **Quantity** (*1,000 kg*) | | |
| 1989 | 329 | 3,518 | (3,189) |
| 1990 | 3,159 | 2,795 | 364 |
| 1991 | 1,354 | 3,277 | (1,923) |
| 1992 | 2,172 | 78 | (2,093) |
| 1993 | 2,553 | 160 | 2,393 |
| | **Value** (*1,000 dollars*) | | |
| 1989 | 293 | 1,892 | (1,599) |
| 1990 | 3,643 | 1,684 | 1,959 |
| 1991 | 1,493 | 2,512 | (1,019) |
| 1992 | 1,762 | 138 | 1,624 |
| 1993 | 2,593 | 357 | 2,237 |
| | **Unit value** (*per kg*) | | |
| 1989 | $0.89 | $0.54 | - |
| 1990 | 1.15 | .60 | - |
| 1991 | 1.10 | .77 | - |
| 1992 | .81 | 1.76 | - |
| 1993 | 1.02 | 2.23 | - |

Note.—Unit values calculated from unrounded figures.
Source: Compiled from official statistics of the U.S. Department of Commerce.

**Table A-12**
**Wheat (except durum)[1] seeds of a kind used for sowing (HTS 1001.90.10): U.S. exports, imports, and trade balance, 1989-93**

| Year | Exports | Imports | Trade balance |
|---|---|---|---|
| | **Quantity** (*1,000 kg*) | | |
| 1989 | 140,790 | 2,578 | 138,212 |
| 1990 | 172,865 | 462 | 172,469 |
| 1991 | 166,927 | 1,284 | 165,643 |
| 1992 | 141,758 | 5,715 | 136,043 |
| 1993 | 23,741 | 10,113 | 13,628 |
| | **Value** (*1,000 dollars*) | | |
| 1989 | 47,622 | 517 | 47,105 |
| 1990 | 56,558 | 82 | 56,488 |
| 1991 | 57,391 | 157 | 57,234 |
| 1992 | 48,577 | 794 | 47,783 |
| 1993 | 5,799 | 1,456 | 4,343 |
| | **Unit value** (*per kg*) | | |
| 1989 | $0.34 | $0.20 | - |
| 1990 | .33 | .18 | - |
| 1991 | .34 | .12 | - |
| 1992 | .34 | .14 | - |
| 1993 | .24 | .14 | - |

[1] Durum wheat seed (HTS 1001.10.00.10) is provided for only in import statistics after 1989, not export statistics. Durum wheat seed imports for 1990-93 were:

| | Value (*1,000 dollars*) | Quantity (*1,000 kg*) | Unit value (*Per kg*) |
|---|---|---|---|
| 1990 | 67 | 374 | $0.18 |
| 1991 | 343 | 2,922 | .12 |
| 1992 | 580 | 4,937 | .12 |
| 1993 | 139 | 915 | .15 |

Note.—Unit values calculated from unrounded figures.
Source: Compiled from official statistics of the U.S. Department of Commerce.

**Table A-13**
**Oats seed (HTS 1004.00.00.10[1]): U.S. imports 1989-93**

| Year | Imports |
|---|---|
| | **Quantity** (*1,000 kg*) |
| 1989 | (2) |
| 1990 | 1,508 |
| 1991 | 1,575 |
| 1992 | 860 |
| 1993 | 1,285 |
| | **Value** (*1,000 dollars*) |
| 1989 | (2) |
| 1990 | 310 |
| 1991 | 180 |
| 1992 | 174 |
| 1993 | 263 |
| | **Unit value** (*per kg*) |
| 1989 | (2) |
| 1990 | $0.21 |
| 1991 | .11 |
| 1992 | .20 |
| 1993 | .20 |

[1] Exports, and thus trade balance, are not available for oats seeds.
[2] Not available.

Note.—Unit values calculated from unrounded figures.

Source: Compiled from official statistics of the U.S. Department of Commerce.

**Table A-14**
**Corn (maize) seed (excluding sweet corn) (HTS 1005.10.00): U.S. exports, imports, and trade balance, 1989-93**

| Year | Exports | Imports | Trade balance |
|---|---|---|---|
| | | **Quantity** (*1,000 kg*) | |
| 1989 | 36,857 | 22,672 | 14,185 |
| 1990 | 70,341 | 13,996 | 56,345 |
| 1991 | 93,722 | 10,978 | 82,744 |
| 1992 | 128,510 | 26,809 | 101,701 |
| 1993 | 88,729 | 22,969 | 65,760 |
| | | **Value** (*1,000 dollars*) | |
| 1989 | 68,538 | 36,913 | 31,625 |
| 1990 | 138,382 | 18,004 | 120,378 |
| 1991 | 180,837 | 14,679 | 166,158 |
| 1992 | 177,159 | 35,219 | 141,940 |
| 1993 | 167,619 | 29,304 | 138,315 |
| | | **Unit value** (*per kg*) | |
| 1989 | $1.86 | $1.63 | - |
| 1990 | 1.97 | 1.29 | - |
| 1991 | 1.93 | 1.34 | - |
| 1992 | 1.38 | 1.31 | - |
| 1993 | 1.89 | 1.28 | - |

Note.—Unit values calculated from unrounded figures.

Source: Compiled from official statistics of the U.S. Department of Commerce.

**Table A-15**
**Grain sorghum seeds of a kind for sowing (HTS 1007.00.00.20): U.S. exports, imports, and trade balance, 1989-93**

| Year | Exports | Imports | Trade balance |
|---|---|---|---|
| | Quantity (*1,000 kg*) | | |
| 1989 | 71,531 | 384 | 71,146 |
| 1990 | 38,607 | 5,829 | 32,778 |
| 1991 | 45,314 | 1,592 | 43,722 |
| 1992 | 192,588 | 135 | 192,453 |
| 1993 | 165,512 | 315 | 165,197 |
| | Value (*1,000 dollars*) | | |
| 1989 | 55,034 | 46 | 54,988 |
| 1990 | 27,215 | 714 | 26,500 |
| 1991 | 27,522 | 211 | 27,312 |
| 1992 | 33,940 | 114 | 33,826 |
| 1993 | 34,494 | 81 | 34,413 |
| | Unit value (*per kg*) | | |
| 1989 | $0.77 | $0.12 | - |
| 1990 | .70 | .12 | - |
| 1991 | .61 | .13 | - |
| 1992 | .18 | .85 | - |
| 1993 | .21 | .26 | - |

Note.—Unit values calculated from unrounded figures.

Source: Compiled from official statistics of the U.S. Department of Commerce.

**Table A-16**
**Sugar beet seed (HTS 1209.11.00): U.S. exports, imports, and trade balance, 1989-93**

| Year | Exports | Imports | Trade balance |
|---|---|---|---|
| | Quantity (*1,000 kg*) | | |
| 1989 | 189 | 1,067 | (878) |
| 1990 | 196 | 143 | 53 |
| 1991 | 420 | 223 | 197 |
| 1992 | 386 | 22 | 364 |
| 1993 | 775 | 24 | 751 |
| | Value (*1,000 dollars*) | | |
| 1989 | 836 | 1,158 | (323) |
| 1990 | 2,274 | 192 | 2,081 |
| 1991 | 3,188 | 120 | 3,068 |
| 1992 | 2,678 | 360 | 2,318 |
| 1993 | 3,457 | 391 | 3,066 |
| | Unit value (*per kg*) | | |
| 1989 | $4.41 | $1.09 | - |
| 1990 | 11.57 | 1.34 | - |
| 1991 | 7.59 | .54 | - |
| 1992 | 6.94 | 16.57 | - |
| 1993 | 4.46 | 16.10 | - |

Note.—Unit values calculated from unrounded figures.

Source: Compiled from official statistics of the U.S. Department of Commerce.

**Table A-17**
**Beet seed, except sugar beet (HTS 1209.19.00): U.S. exports, imports, and trade balance, 1989-93**

| Year | Exports | Imports | Trade balance |
|---|---|---|---|
| | Quantity (*1,000 kg*) | | |
| 1989 | 539 | 5 | 534 |
| 1990 | 676 | 4 | 672 |
| 1991 | 746 | 4 | 742 |
| 1992 | 1,006 | 12 | 994 |
| 1993 | 588 | ([1]) | 558 |
| | Value (*1,000 dollars*) | | |
| 1989 | 2,218 | 76 | 2,142 |
| 1990 | 2,927 | 30 | 2,897 |
| 1991 | 3,259 | 36 | 3,223 |
| 1992 | 4,549 | 32 | 4,517 |
| 1993 | 2,688 | 15 | 2,673 |
| | Unit value (*per kg*) | | |
| 1989 | $4.12 | $16.97 | - |
| 1990 | 4.33 | 8.51 | - |
| 1991 | 4.37 | 8.66 | - |
| 1992 | 4.52 | 2.59 | - |
| 1993 | 4.55 | 42.55 | - |

[1] Less than 500 kg.

Note.—Unit values calculated from unrounded figures.

Source: Compiled from official statistics of the U.S. Department of Commerce.

**Table A-18**
**Alfalfa (lucerne) seed (HTS 1209.21): U.S. exports, imports, and trade balance, 1989-93**

| Year | Exports | Imports | Trade balance |
|---|---|---|---|
| | Quantity (*1,000 kg*) | | |
| 1989 | 9,011 | 4,475 | 4,536 |
| 1990 | 9,794 | 3,778 | 6,016 |
| 1991 | 8,254 | 3,685 | 4,569 |
| 1992 | 13,452 | 3,575 | 9,877 |
| 1993 | 13,830 | 2,640 | 11,191 |
| | Value (*1,000 dollars*) | | |
| 1989 | 28,202 | 6,596 | 21,606 |
| 1990 | 28,408 | 7,232 | 21,176 |
| 1991 | 26,583 | 6,855 | 19,728 |
| 1992 | 35,084 | 5,583 | 29,502 |
| 1993 | 34,418 | 4,354 | 30,064 |
| | Unit value (*per kg*) | | |
| 1989 | $3.13 | $1.47 | - |
| 1990 | 2.90 | 1.91 | - |
| 1991 | 3.22 | 1.86 | - |
| 1992 | 2.61 | 1.56 | - |
| 1993 | 2.49 | 1.65 | - |

Note.—Unit values calculated from unrounded figures.

Source: Compiled from official statistics of the U.S. Department of Commerce.

**Table A-19**
**Clover seed (HTS 1209.22): U.S. exports, imports, and trade balance, 1989-93**

| Year | Exports | Imports | Trade balance |
|---|---|---|---|
| | Quantity (*1,000 kg*) | | |
| 1989 | 2,596 | 9,861 | (7,265) |
| 1990 | 2,566 | 9,976 | (7,410) |
| 1991 | 2,587 | 8,188 | (5,601) |
| 1992 | 1,815 | 8,298 | (6,483) |
| 1993 | 3,071 | 7,165 | (4,094) |
| | Value (*1,000 dollars*) | | |
| 1989 | 4,722 | 9,319 | (4,596) |
| 1990 | 4,464 | 8,873 | (4,408) |
| 1991 | 3,563 | 7,221 | (3,657) |
| 1992 | 4,377 | 7,917 | (3,540) |
| 1993 | 5,827 | 7,761 | (1,934) |
| | Unit value (*per kg*) | | |
| 1989 | $1.82 | $0.94 | - |
| 1990 | 1.74 | .89 | - |
| 1991 | 1.38 | .88 | - |
| 1992 | 2.41 | .95 | - |
| 1993 | 1.90 | 1.08 | - |

Note.—Unit values calculated from unrounded figures.

Source: Compiled from official statistics of the U.S. Department of Commerce.

**Table A-20**
**Fescue seed (HTS 1209.23): U.S. exports, imports, and trade balance, 1989-93**

| Year | Exports | Imports | Trade balance |
|---|---|---|---|
| | Quantity (*1,000 kg*) | | |
| 1989 | 6,956 | 12,144 | (5,189) |
| 1990 | 10,928 | 10,203 | 725 |
| 1991 | 8,545 | 11,847 | (3,302) |
| 1992 | 8,188 | 14,493 | (6,304) |
| 1993 | 7,248 | 12,880 | (5,632) |
| | Value (*1,000 dollars*) | | |
| 1989 | 11,241 | 14,668 | (3,427) |
| 1990 | 11,503 | 9,383 | 2,120 |
| 1991 | 10,565 | 9,506 | 1,059 |
| 1992 | 10,080 | 17,792 | (7,711) |
| 1993 | 9,232 | 14,930 | (5,698) |
| | Unit value (*per kg*) | | |
| 1989 | $1.62 | $1.21 | - |
| 1990 | 1.05 | .92 | - |
| 1991 | 1.24 | .80 | - |
| 1992 | 1.23 | 1.23 | - |
| 1993 | 1.27 | 1.16 | - |

Note.—Unit values calculated from unrounded figures.

Source: Compiled from official statistics of the U.S. Department of Commerce.

**Table A-21**
**Kentucky blue grass seed (HTS 1209.24.00): U.S. exports, imports, and trade balance, 1989-93**

| Year | Exports | Imports | Trade balance |
|---|---|---|---|
| | Quantity (*1,000 kg*) | | |
| 1989 | 2,889 | 1,118 | 1,771 |
| 1990 | 5,814 | 426 | 5,389 |
| 1991 | 4,056 | 262 | 3,794 |
| 1992 | 3,362 | 778 | 2,584 |
| 1993 | 2,270 | 397 | 1,872 |
| | Value (*1,000 dollars*) | | |
| 1989 | 6,621 | 2,332 | 4,289 |
| 1990 | 8,721 | 500 | 8,222 |
| 1991 | 6,118 | 284 | 5,835 |
| 1992 | 7,698 | 1,617 | 6,081 |
| 1993 | 6,750 | 894 | 5,856 |
| | Unit value (*per kg*) | | |
| 1989 | $2.29 | $2.09 | - |
| 1990 | 1.50 | 1.17 | - |
| 1991 | 1.51 | 1.08 | - |
| 1992 | 2.29 | 2.08 | - |
| 1993 | 2.97 | 2.25 | - |

Note.—Unit values calculated from unrounded figures.

Source: Compiled from official statistics of the U.S. Department of Commerce.

**Table A-22**
**Rye grass seed (HTS 1209.25): U.S. exports, imports, and trade balance, 1989-93**

| Year | Exports | Imports | Trade balance |
|---|---|---|---|
| | Quantity (*1,000 kg*) | | |
| 1989 | 11,460 | 5,020 | 6,440 |
| 1990 | 13,640 | 6,160 | 7,480 |
| 1991 | 16,162 | 2,350 | 13,812 |
| 1992 | 16,298 | 3,492 | 12,806 |
| 1993 | 12,576 | 6,932 | 5,644 |
| | Value (*1,000 dollars*) | | |
| 1989 | 8,290 | 3,993 | 4,297 |
| 1990 | 9,371 | 4,883 | 4,488 |
| 1991 | 10,363 | 1,935 | 8,428 |
| 1992 | 10,839 | 3,369 | 7,470 |
| 1993 | 9,335 | 7,222 | 2,113 |
| | Unit value (*per kg*) | | |
| 1989 | $0.72 | $0.80 | - |
| 1990 | .69 | .79 | - |
| 1991 | .64 | .82 | - |
| 1992 | .67 | .96 | - |
| 1993 | .74 | 1.04 | - |

Note.—Unit values calculated from unrounded figures.

Source: Compiled from official statistics of the U.S. Department of Commerce.

**Table A-23**
**Timothy grass seed (HTS 1209.26): U.S. exports, imports, and trade balance, 1989-93**

| Year | Exports | Imports | Trade balance |
|---|---|---|---|
| | | Quantity (*1,000 kg*) | |
| 1989 | 1,666 | 2,731 | (1,065) |
| 1990 | 1,866 | 1,488 | 378 |
| 1991 | 958 | 1,858 | (901) |
| 1992 | 1,142 | 3,627 | (2,485) |
| 1993 | 1,285 | 3,011 | (1,726) |
| | | Value (*1,000 dollars*) | |
| 1989 | 2,028 | 2,898 | (869) |
| 1990 | 1,251 | 1,146 | 104 |
| 1991 | 899 | 1,213 | (314) |
| 1992 | 1,324 | 2,669 | (1,345) |
| 1993 | 1,729 | 2,637 | (908) |
| | | Unit value (*per kg*) | |
| 1989 | $1.22 | $1.06 | - |
| 1990 | .67 | .77 | - |
| 1991 | .94 | .65 | - |
| 1992 | 1.16 | .74 | - |
| 1993 | 1.35 | .88 | - |

Note.—Unit values calculated from unrounded figures.

Source: Compiled from official statistics of the U.S. Department of Commerce.

**Table A-24**
**Seeds of forage plants, nesoi (HTS 1209.29): U.S. exports, imports, and trade balance, 1989-93**

| Year | Exports | Imports | Trade balance |
|---|---|---|---|
| | | Quantity (*1,000 kg*) | |
| 1989 | 19,506 | 2,017 | 17,489 |
| 1990 | 26,466 | 2,454 | 24,012 |
| 1991 | 22,215 | 2,777 | 19,438 |
| 1992 | 25,410 | 4,234 | 21,176 |
| 1993 | 26,530 | 3,964 | 22,566 |
| | | Value (*1,000 dollars*) | |
| 1989 | 34,792 | 3,772 | 31,020 |
| 1990 | 40,645 | 3,136 | 37,509 |
| 1991 | 42,551 | 3,797 | 38,754 |
| 1992 | 44,791 | 6,498 | 38,293 |
| 1993 | 48,757 | 6,763 | 41,993 |
| | | Unit value (*per kg*) | |
| 1989 | $1.78 | $1.87 | - |
| 1990 | 1.54 | 1.28 | - |
| 1991 | 1.92 | 1.37 | - |
| 1992 | 1.76 | 1.53 | - |
| 1993 | 1.84 | 1.71 | - |

Note.—Unit values calculated from unrounded figures.

Source: Compiled from official statistics of the U.S. Department of Commerce.

**Table A-25**
**Seeds of herbaceous plants cultivated principally for their flowers (HTS 1209.30.00): U.S. exports, imports, and trade balance, 1989-93**

| Year | Exports | Imports | Trade balance |
|---|---|---|---|
| | | **Quantity** (*1,000 kg*) | |
| 1989 | 376 | 231 | 145 |
| 1990 | 283 | 224 | 59 |
| 1991 | 232 | 256 | (24) |
| 1992 | 280 | 212 | 69 |
| 1993 | 207 | 284 | (77) |
| | | **Value** (*1,000 dollars*) | |
| 1989 | 10,978 | 24,448 | (13,470) |
| 1990 | 12,519 | 23,357 | (10,838) |
| 1991 | 14,161 | 24,356 | (10,194) |
| 1992 | 18,930 | 27,167 | (8,237) |
| 1993 | 19,380 | 31,772 | (12,392) |
| | | **Unit value** (*per kg*) | |
| 1989 | $29.21 | $105.97 | - |
| 1990 | 44.31 | 104.43 | - |
| 1991 | 60.94 | 95.12 | - |
| 1992 | 67.56 | 128.41 | - |
| 1993 | 93.49 | 111.92 | - |

Note.—Unit values calculated from unrounded figures.

Source: Compiled from official statistics of the U.S. Department of Commerce.

**Table A-26**
**Vegetable seeds (HTS 1209.91): U.S. exports, imports, and trade balance, 1989-93**

| Year | Exports | Imports | Trade balance |
|---|---|---|---|
| | | **Quantity** (*1,000 kg*) | |
| 1989 | 14,577 | 5,695 | 8,881 |
| 1990 | 16,605 | 4,544 | 12,061 |
| 1991 | 17,389 | 4,900 | 12,490 |
| 1992 | 18,727 | 4,841 | 13,886 |
| 1993 | 18,128 | 5,327 | 12,801 |
| | | **Value** (*1,000 dollars*) | |
| 1989 | 89,768 | 39,308 | 50,460 |
| 1990 | 98,757 | 44,873 | 53,884 |
| 1991 | 120,630 | 52,277 | 68,353 |
| 1992 | 130,532 | 57,652 | 72,880 |
| 1993 | 126,136 | 53,473 | 72,662 |
| | | **Unit** value (*per kg*) | |
| 1989 | $6.16 | $6.90 | - |
| 1990 | 5.95 | 9.88 | - |
| 1991 | 6.94 | 10.67 | - |
| 1992 | 6.97 | 11.91 | - |
| 1993 | 6.96 | 10.04 | - |

Note.—Unit values calculated from unrounded figures.

Source: Compiled from official statistics of the U.S. Department of Commerce.

**Table A-27**
**Tree and shrub seeds, and other seeds, fruits and spores, of a kind used for sowing, nesoi (HTS 1209.99): U.S. exports, imports, and trade balance, 1989-93**

| Year | Exports | Imports | Trade balance |
|---|---|---|---|
| | **Quantity** (*1,000 kg*) | | |
| 1989 | 5,717 | 3,129 | 2,588 |
| 1990 | 5,331 | 2,132 | 3,198 |
| 1991 | 4,992 | 4,091 | 901 |
| 1992 | 3,717 | 1,793 | 1,924 |
| 1993 | 4,514 | 1,427 | 3,087 |
| | **Value** (*1,000 dollars*) | | |
| 1989 | 24,367 | 17,142 | 7,225 |
| 1990 | 25,421 | 16,851 | 8,570 |
| 1991 | 31,135 | 24,543 | 6,593 |
| 1992 | 26,914 | 21,648 | 5,266 |
| 1993 | 30,486 | 24,174 | 6,312 |
| | **Unit value** (*per kg*) | | |
| 1989 | $4.26 | $5.48 | - |
| 1990 | 4.77 | 7.90 | - |
| 1991 | 6.24 | 6.00 | - |
| 1992 | 7.24 | 12.07 | - |
| 1993 | 6.75 | 16.94 | - |

Note.—Unit values calculated from unrounded figures.

Source: Compiled from official statistics of the U.S. Department of Commerce.