Industry & Trade Summary

Pesticide Products and Formulations

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UNITED STATES INTERNATIONAL TRADE COMMISSION

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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 pesticide products and formulations primarily covers the period 1988-92 and represents one of approximately 250 to 300 individual reports to be produced in this series during the first half of the 1990s. Listed below are the individual summary reports published to date on the chemicals and textiles sectors.

USITC publication number	*Publication date*	*Title*
Chemicals:		
2458	November 1991	Soaps, Detergents, and Surface-Active Agents
2509	May 1992	Inorganic Acids
2548	August 1992	Paints, Inks, and Related Items
2578	November 1992	Crude Petroleum
2588	December 1992	Major Primary Olefins
2590	February 1993	Polyethylene Resins in Primary Forms
2598	March 1993	Perfumes, Cosmetics, and Toiletries
2736	February 1994	Antibiotics
2741	February 1994	Natural Rubber
2743	February 1994	Saturated Polyester Resins in Primary Forms
2747	March 1994	Fatty chemicals
2750	March 1994	Pesticide Products and Formulations
Textiles and apparel:		
2543	August 1992	Nonwoven Fabrics
2580	December 1992	Gloves
2642	June 1993	Yarn
2695	November 1993	Carpets and Rugs
2702	November 1993	Fur Goods
2703	November 1993	Coated Fabrics

[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.

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INTRODUCTION

The information covered in this industry and trade summary on pesticide products and formulations covers the period from 1988 to 1992. At times, however, the report will place this period in historical perspective by referencing information from earlier periods. The report is organized into three sections. The first section, profiling the U.S. and foreign industries, discusses the structure of the industries, the characteristics of demand, and the market environment. Primary emphasis will be on the U.S. industry. The second section will review U.S. and foreign trade measures. The third section will review the performance of the U.S. pesticide industry in the domestic market, as indicated by consumption, imports, and production; and review the performance of the U.S. pesticide industry in foreign markets as indicated by exports, the foreign market structure, and the trade balance.

The products covered in the summary are pesticide "active ingredients" and pesticide "formulations" packaged for retail sale.[1] "Active ingredients" are complex chemicals, manufactured in a series of reactions using a variety of chemical intermediates, that produce a desired pesticidal activity (for example, destroy or limit the growth of weeds or insects). "Formulations" are active ingredients that have been combined with inert materials and adjuvants to produce a finished product, packaged for retail, and ready for consumption. The more common formulation additives include surfactants, clays, diluents, talcs, and stickers (for example, soaps and oils); while the more common formulations include sprays, dusts, aerosols, fumigants, combinations with fertilizer, baits, impregnates, and slow-release pesticides. Pesticides are also made from natural products, inorganic compounds, and more recently from biotechnology processes. Inorganic compounds are relatively inexpensive and used in large quantities in certain applications, particularly as fumigants. A brief discussion of biotech and naturally occurring pesticides is given below. As issues claim their attention, these products will be mentioned in various places throughout the summary. But, since they represent a relatively small portion of the total value of pesticide sales, data related to these products will not be presented in the production, import, export, or trade balance tables.

The following paragraphs define selected industry terms and review the major pesticide product classifications used in this summary:

Aggregate markets.—There are four aggregate markets for pesticides—agricultural, commercial and industrial, home and garden, and government.

End-use market.—End-use market refers to the specific product use (within an aggregate commercial market) to which a pesticide is applied—for example, the wheat herbicide market, the corn insecticide market, or the household insecticide market.

Pesticide classifications.—Pesticides are classified into broad categories based on the type of pest to be controlled. The three classifications primarily discussed in this summary are herbicides, insecticides, and fungicides. These and other categories are defined below.

Herbicides.[2]—Herbicides (in both value and quantity) is the largest class of pesticides used in the United States, as well as in the world. This class of pesticides, which accounts for approximately 50 percent of the value of aggregate world pesticide use, is used to destroy or control a wide variety of weeds and other unwanted plants. Because of its demonstrated farm labor savings, nearly all the agricultural land in the United States is currently being treated with some type of herbicide. In recent years, approximately 50 percent of total U.S. pesticide consumption (by value) was herbicides; approximately 15 percent of herbicide consumption was imported; and approximately 45 percent of U.S. herbicide production was exported.

One of the first and most widely used synthetic herbicides is 2,4-dichlorophenoxyacetic acid (2,4-D). This selective herbicide, introduced in 1945, was the first in a series of phenoxyacetic acid herbicides. Today, it is used to control broadleaf weeds primarily in cornfields and lawns.

Until 1959, most herbicides were used for postemergence treatments (i.e., applied to growing weeds), as in the case of 2,4-D and its derivatives. Since that time, the pesticide industry has developed a number of preemergence herbicides, which have been successfully introduced in domestic markets. In 1974, it was estimated that 70 percent of the land treated with herbicides was treated with a preemergence herbicide.[3] Today, this percentage is believed to be much higher, as farmers realize the cost savings from less tillage through preemergence treatments.

Insecticides.—Insecticides is the second largest pesticide category (by value) used in the United States and in the world. In recent years, insecticides accounted for approximately 29 percent of the total value of U.S. pesticide consumption, some 10 percent of which was imported material. Also in recent years, U.S. manufacturers exported approximately 40 percent of their total production. Historically, the category of synthetic organic insecticides has been divided into one of four major chemical groups: (1) organochlorines such as dichlorodiphenyl trichloroethane (DDT) and chlordane; (2) organophosphates such as parathion and diazinon; (3) carbamates such as carbaryl; and (4) the pyrethroids (including both natural and synthetic

[1] The term "pesticide" is a generic term referring to either a formulation or an active ingredient.

[2] Historical information excerpted from USITC, *Summary of Trade and Tariff Information: Synthetic Organic Pesticides*, Publication 841, Apr. 1981, pp. 29–5.

[3] Jack R. Plimmer, *Pesticide Chemistry in the 20th Century*, Washington, DC, American Chemical Society, 1977, p. 50.

varieties). Insect control through the use of synthetic chemicals began in 1942 with the introduction of DDT. This chemical was used with great success in World War II to control insects that transmit malaria, typhus, and yellow fever.

Several new compounds, discovered during the 1950s, found widespread use in agriculture because of their unusual toxicity to a variety of insects. However, the qualities that made these chemicals so desirable also led to their eventual removal from the market, as these products also proved harmful to humans and to the environment. Spurred in part by increased environmental concern, researchers developed a new series of less toxic synthetic compounds called pyrethroids. These compounds are based on the natural pyrethroids, which are found in such plants as the chrysanthemum.

Fungicides.—In recent years, fungicides accounted for approximately 10 percent of the value of total U.S. pesticide consumption, approximately 15 percent of which was imported material. U.S. manufacturers exported almost 25 percent of what they manufactured. Fungicides are used primarily to protect agricultural crops and seeds from various fungi. Before synthetic fungicides were developed in the 1930s, farmers used inorganic products, such as elemental sulfur and copper sulfate. Initially, synthetic products were commercially unsuccessful, because of their high manufacturing costs. By the 1940s however, newer, less expensive products, such as the 2-ethylene-bisdithiocarbamates, became commercially successful. Today, fungicides are manufactured from a variety of chemical classes, including the dithiocarbamates, phenols, carboxins, nitrophenols, pyrimidines, pyridines, quinones, and organometallic compounds containing such metal ions as mercury, cadmium, lead, and arsenic. Commercially, however, the most important fungicides are halogenated compounds, the carbamates and dithiocarbamates, and organophosphates.

Plant growth regulators.—In their efforts to improve crop production, many companies developed a new class of compounds known as plant growth regulators. Plant growth regulators are produced for a variety of purposes, including loosening ripened fruits for faster harvest; controlling the size and firmness of fruits; and regulating the size of a plant to increase branching. These products account for a small portion of world and U.S. usage. Future development will probably be directed toward selected crops for which the application of these specialty products is found to be the most cost effective.

Other pesticides.—Although small in total quantity consumed, a number of other classes of pesticide products are on the market. For example, fumigants are used to control larvae and insects primarily in grain elevators and soil. These chemicals include chlorinated and brominated alkyl hydrocarbons such as methyl bromide and 1,3-dichloropropene. Another class of pesticides contains sex attractants and insect growth regulators. Sex attractants are synthetically produced compounds used to confuse specific male insects, making it difficult to locate females for mating. Insect growth regulators, such as juvenile growth hormones, are synthetic compounds similar to the chemicals that regulate insect growth. Commercial success to date has been limited by their relative cost. Nevertheless, research continues in this area, especially because of the low toxicity of these products.

Naturally occurring and biotech pesticides.—Pesticides can also be derived from natural products. One of the more important commercial classes of product is the naturally occurring pyrethroids, found in plants such as chrysanthemums and used as insecticides. Since their discovery, however, a number of synthetic products were developed, and, by the late 1980s, the industry was working on second-generation synthetic products. Another class of naturally occurring pesticides is produced from the bacterium **Bacillus thuringiensis** (Bt.), which includes a number of different insecticides that are biodegradable. Bt. is a highly specific bacterial insecticide that has been used against caterpillars for 20 years. The toxin it produces is harmless to humans, birds, animals, fish, and many beneficial insects. But, unfortunately, the bacterium is fragile and decomposes in sunlight.

Biotechnology applied to agriculture is a shift from chemistry to biology, taking advantage of DNA to manipulate and move genes from one organism to another in the production of specific proteins that act as pesticides. Recent examples of this procedure are the development of two genetically engineered proteins, approved by the U.S. Environmental Protection Agency in 1991, that act as insecticides, one for selected moths and the other for selected caterpillars. The proteins were originally produced by Bt., but because of Bt.'s fragility, the proteins were genetically transferred to another less fragile host.[4]

Of recent interest are new bioherbicide compounds designed to control weeds without producing toxic chemical byproducts. Paralleling this is the development of herbicide-tolerant crops. In fact, the first herbicide-resistant corn hybrids entered the market in 1992, while more are planned to be introduced soon. New second-generation, herbicide-tolerant soybeans, corn, and cotton, many derived from genetic engineering, may be introduced in the next few years with the potential to substantially change herbicide use patterns. These varieties provide crop tolerances to many of the currently available safe and effective broad-spectrum herbicides, and, in the future, may eliminate the need for other more toxic herbicides.[5] In a related development, some biotechnology processes are creating new agricultural products that are, themselves, resistant to disease or insects.

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[4] *Chemical Engineering*, Aug. 1991, p. 23.
[5] *Chemical Marketing Reporter*, May 24, 1993, p. 17.

In recent years, the annual world consumption of biotech pesticide products has been approximately $50 to $100 million, less than 0.5 percent of the recent $20 billion pesticide market. With the exception of biological silage additives, which are replacing conventional acids, biologicals in agriculture are very small segments of their respective markets. Nevertheless, there are more than 300 companies worldwide that, in total, manufacture at least 1,000 products containing 250 different active ingredients. By the beginning of the 21st century, biotechnology science is expected to generate a number of commercially successful agriculture products.[6]

U.S. INDUSTRY PROFILE

Industry Structure[7]

The principal raw materials, producer types, major products, and principal consumers of the U.S. pesticide industry are shown in figure 1, while the major participants in production and distribution are profiled in table 1. Today, the U.S. farmer is the most productive farmer in the world, due in large measure to the contributions of the pesticide, fertilizer, and farm equipment industries. For its part, the pesticide industry produces a variety of chemical products that restrict or destroy specific plants, animals or insects, thereby limiting the loss of agricultural products from unwanted pests.

From 1950 through the early 1980s, aggregate U.S. pesticide consumption increased some fivefold. But by the mid-1980s, the U.S. industry, which, by then, was dominated by large U.S. and European companies, had matured. One industry analyst, while discussing the industry's maturity, predicted annual real growth of both the U.S. and the world pesticide industries would be approximately 1 percent in the 1990s, compared with 2.2 percent in the 1980s and 6.3 percent in the 1970s.[8]

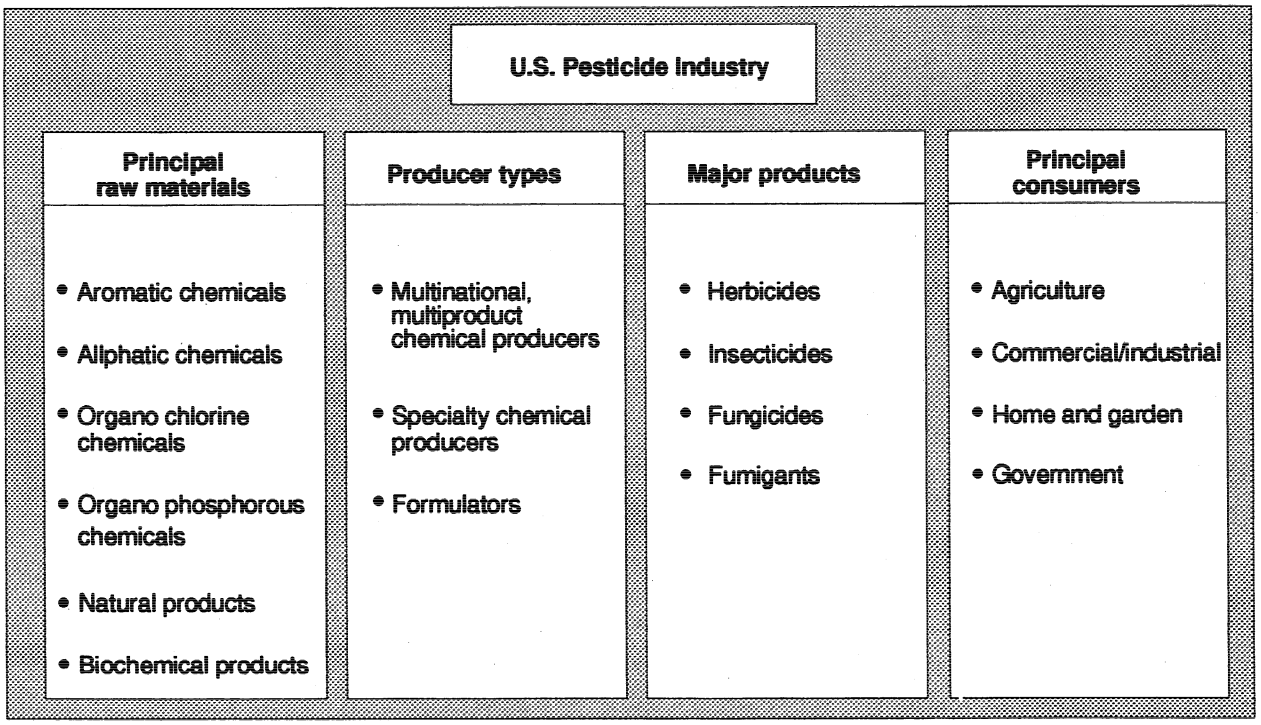
Pesticide producers are often parts of large, vertically integrated, multinational, multiproduct

[6] *European Chemical News*, July 8, 1991, p. 18.

[7] The products covered in this summary correspond approximately with those of SIC 28694, Pesticides and Other Synthetic Organic Agriculture Chemicals (except Preparations); SIC 28799, Household Pesticides; and SIC 28798, Pesticides and Agriculture Chemicals, Not Elsewhere Classified.

[8] Allan Woodburn, AWA Ltd. Consultants, Edinburgh, Scotland, *Agrochemicals-into the 1990s*, Dec. 1991.

Figure 1
U.S. pesticide industry: Principal raw materials, producer types, major products, and principal consumers



Source: Compiled by the staff of the U.S. International Trade Commission from various sources.

Table 1
U.S. pesticide production and distribution profile, 1991

Item	Number
Basic production:	
Major basic producers	60
Other producers	20
Employment	10,000
Active ingredients registered	900
Active ingredients in production	850
Leading active ingredients in production	200
New active ingredients per year	8-12
Marketing level:	
Formulators	2,200
Distributors and establishments	20,000
Formulated products registered at the Federal level	30,000
Registered agriculture applicators	950,000
Certified commercial applicators	325,000
User level:	
Million farms	2.1
Million farms using some pesticide	0.6-1.0
Million households	90
Million households using some pesticide	69
Other industry/government users	(1)

[1] Several million.

Source: U.S. Environmental Protection Agency and U.S. International Trade Commission staff estimates.

companies with production sites both in their home countries and throughout the world. For these larger companies, pesticide sales account for a relatively small portion of each company's total sales (table 2); and for the pesticide industry as a whole, pesticide products account for only a small portion of the total chemical industry sales. Although smaller pesticide companies exist throughout the world, including the United States, they usually specialize in a few products and account for approximately 20 percent of world sales.

The structure of the U.S. pesticide industry can be analyzed either commercially (in terms of production facilities and distribution channels) or by end-use markets. Commercial analysis provides an overview of the industry's structure, while end-use market analysis gives added insight into pricing and other competitive forces that influence the conduct and performance of an industry.[9]

For commercial analysis, the industry structure can be divided into four distinct segments: (1) basic active ingredient production, in which the active ingredient is synthesized from various chemical intermediates; (2) formulation, in which the active ingredient is mixed with various materials to obtain a product suitable for use; (3) distribution; and (4) retailing.

In 1992, there were approximately 120 companies in the United States that manufactured active ingredients (AI) and formulations. This number included both large multinational corporations and smaller domestic companies. Of the large multinational companies, many are subsidiaries of European companies. AI production techniques are relatively capital intensive. When possible, the larger producers

[9] Economic analysis often attempts to draw conclusions according to how the structure of an industry affects the conduct of an industry, which in turn affects the performance of the industry. This summary will only briefly mention certain aspects of the industry that could be used in such an analysis.

Table 2
Major U.S. and European pesticides producers' sales profile, 1989

Company	Sales		Pesticides' share	Distribution of pesticides sales	
	Total	Pesticides		United States	Europe
	Million dollars		Percent	Percent	
Ciba-Geigy (Switzerland)	13,356	2,410	18	33	34
Bayer (Germany)	25,621	2,070	8	15	41
ICI (United Kingdom)	21,244	1,920	9	28	32
Rhone Poulenc (France)	12,628	1,848	15	24	49
DuPont (United States)	35,534	1,685	5	44	24
Monsanto (United States)	8,681	1,558	18	46	26
Dow Elanco (United States)	1,480	1,480	100	54	26
Hoechst (Germany)	27,159	1,200	5	15	55
BASF (Germany)	28,175	1,189	4	24	45
Shell (Holland)	84,139	985	1	-	45
Schering (Germany)	3,459	824	24	12	65
American Cyanamid (United States)	4,825	760	16	59	20
Sandoz (Switzerland)	8,100	755	9	33	27
FMC (United States)	3,414	420	12	49	-
Rohm & Haas (United States)	2,661	367	14	29	33

Source: International Group of National Associations of Agrochemical Manufacturers.

will integrate pesticide production into a major chemical manufacturing complex to take advantage of "economies of scope."[10] Furthermore, because of economies of scale,[11] a specific pesticide AI may be produced, in large quantities, in one location and then shipped throughout the world for formulation and distribution. In the United States, many production facilities are located near historic chemical producing areas, such as the East Coast and the Gulf of Mexico. However, geography imposes no real strategic or financial constraint to AI plant location. With formulation and distribution, however, location becomes a more strategic factor, since the need to offer technical services and maintain customer contact requires closer proximity to the final customer.

Consolidation: joint ventures and mergers[12]

As indicated in the following tabulation, the U.S. pesticide industry witnessed a number of major consolidations and joint ventures during the 1980s:[13]

Buyer	Seller
Avery	Uniroyal
BASF	Rohm and Haas
DuPont	Shell
Fermenta	Diamond Shamrock
ICI Americas	Stauffer
Rhone Poulenc	Union Carbide
Sandoz	Velsicol

Some analysts believe that by the end of the century, the number of major world producers could decline from approximately 25 to around 10.[14] These analysts noted that in a mature, competitive market with fluctuating demand (based on agricultural demand) and increasing costs (related to both product development and environmental regulation), mergers are likely to occur. They further noted that many of the consolidations referenced in the above tabulation occurred during the downturn in the crop cycle in the mid 1980s.

Product development and regulatory compliance costs have increased significantly in recent years. It has been reported that the current cost for developing a successful new product is between $25 million and $50 million, and that development takes, on average, 7 to 8 years. In addition, only one in approximately 25,000 products tested becomes a commercially successful pesticide product[15]. In complying with the reregistration process required by the 1988 Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) amendments (see below), some companies have reportedly spent 30 percent of their research budgets on reregistration. Reregistration has been particularly difficult for minor-use and specialized pesticides.[16] As a consequence of these increased development and compliance costs (fixed costs), companies require an ever- increasing sales volume.

In summary, if the patents on successful products expire and a company is unable to develop new products, or if new competitive products enter the market, or if there is a decline in a product's pesticide effectiveness, a company's revenues and earnings can rapidly diminish. Many analysts relate the recent increase in horizontal integration (from mergers, buyouts, and joint ventures) to companies (a) having to cover high fixed and operating costs and (b) lacking new innovative products, rather than to the desire of a few companies to dominate the industry.

With many large multiproduct chemical pesticides producers, upstream vertical integration is common throughout the production of the active ingredients. There is, however, less downstream vertical integration into product formulation, distribution, and sales. Although larger companies engage in formulation and distribution, particularly for their new proprietary products, approximately 300 independent distributors and formulators in the United States offer these same services in addition to related services such as extending credit, formulating with fertilizers, and applying the pesticide.

The structure of the pesticide industry can be further analyzed in terms of end-use markets. From this perspective, the economic implications of the industry's structure on conduct and performance can be analyzed in more detail. For example, the overall structure of the active ingredient producers may not appear to be particularly concentrated.[17] However, the

[10] "Economies of scope" exist when it is more efficient to produce two or more goods together using common production inputs, thereby spreading production costs over more than one output.

[11] Economies of scale exist when a firm's average cost falls as its output increases.

[12] Mergers have been generally placed in one of three categories: horizontal mergers—involving firms producing the same products; vertical mergers—involving firms producing at varying stages of a finished product; and conglomerate mergers—involving firms producing in entirely different markets. Vertical mergers are further divided into "upstream" and "downstream" mergers. An upstream merger refers to a company integrating backward into the production process, whereas a downstream merger refers to a company merging forward into production, distribution, and perhaps sales. For further analysis of merger activity, see Dennis Carlton and Jeffrey Perloff, *Modern Industrial Organization*, 1989, ch. 7.

[13] This tendency toward consolidation is not unique to the United States, but can be found throughout the world, particularly in Europe. For example, some chemical trade journals report that sometime in early 1994, two European companies, Schering and Hoechst, expect to consolidate a joint venture.

[14] Chemical Marketing Reporter, "Farm Chemicals '91, a CMR Special Report," May 20, 1991.

[15] "Environmental conccerns force global changes in the market" *Chemical Week*, May 4, 1990, pp. 22-39.

[16] Minor-use pesticides are used on crops such as fresh fruits and vegetables, whose markets can be small relative to those for major crops such as corn, cotton, wheat, and soybeans. Total acreage for fruits and vegetables is some 8 million acres, while acreage for the major products is about 220 million acres.

[17] "Concentration" is measured by various meyhods to determine how much market control the leading companies have in a given industry.

industry's structure is more concentrated when viewed by the appropriate end-use market. Pesticidal activity is, in most cases, limited to only one class of pests (e.g., insecticides are not effective herbicides). Furthermore, within a class of pesticide, the appropriate market definition (in many cases) would be no larger than a specific pesticide used for a particular crop (for example, corn herbicides or cotton herbicides). Herbicides can be further differentiated by the time of the growing year in which they are applied. For example, herbicides applied before a crop is planted (preemergence) do not compete directly with herbicides that are applied after a crop has started to grow (postemergence).[18] It is only in well-defined end-use markets that products compete, and only in these markets can a company's conduct and performance be accurately measured—in particular their ability to control price and quantity.

Pricing and other competitive forces

The average price per kilogram of pesticides' active ingredients in 1988 and 1991 are given in the following tabulation:

Product	1988	1991
Herbicides	$9.58	$10.03
Insecticides	10.30	10.97
Fungicides	9.70	7.51
Average	9.86	9.50

Source: USITC publication, *Synthetic Organic Chemicals, United States Production and Sales.*

Without translation into per-acre prices, these prices are of limited value, since individual pesticide products are applied in different quantities per acre. Wholesale pesticide prices are influenced both by production costs and by the need to cover current and future research and development and environmental compliance expenditures. At the retail level, pricing is also influenced by distribution and marketing costs, which vary from product to product. With newer patented products, the active ingredients producers are more likely to follow the distribution and sale of their products from production through distribution, supplying the necessary technical support. With the older commodity products, formulators and dealers are more likely to participate in the distribution chain and to supply the necessary technical information.

The retail end-use pesticides market is many submarkets, each of which is often dominated by a few products. In 1990, five herbicides accounted for approximately 75 percent of herbicides consumption, and five insecticides accounted for 90 percent of insecticides consumption in corn agriculture. In addition to the limited number of products (per submarket), demand is considered relatively inelastic; regulatory compliance costs may be a barrier to entry; and product substitution is limited by technical considerations. Although such conditions might be conducive to monopolistic pricing and higher than average profits, conduct and performance in these end-use markets are tempered by the dynamic nature of the industry in which market share can change rapidly. In submarkets, changes in market share are most often traced to (1) a reduction, over time, in the efficacy of certain products, as pests build up resistance; (2) the invention of new more effective products, which rapidly attract a larger market share; (3) the removal of older products from the market as a result of environmental concerns; and (4) the expiration of patents enabling competitors to enter the market.

For new proprietary pesticides, high prices are often required to recapture the front-end development costs (including the possible cost of new or modified manufacturing facilities) before patent expiration.[19] Once a product is off patent, competitive pricing becomes a more effective tool to gain market share. In general, price competition is more likely (a) the longer the product has been off patent, (b) the less costly it is to produce the product, (c) the larger the market, (d) the greater the number of competing products, and (e) the older the average life of the competing products. Many analysts believe that competition among pesticide producers occurs mainly in the research and development of new products, as companies vie for market share with newer and more cost-effective products.

Consumer Characteristics and Factors Affecting Demand

The approximate percentage use, by market, during 1988-92 is given in the following tabulation:[20]

Major Market	Average Annual percentage
Agriculture	75%
Commercial and industrial	10%
Home and garden	10%
Government	5%

During the 1970s and 1980s, commercial and industrial uses increased their share of total pesticide consumption, mostly at the expense of home and garden use. This trend has since slowed, and many believe the current distribution will remain for the near

[18] Preemergent herbicides compete technically with postemergent herbicides. If the preemergent herbicide is completely successful, the postemergent product is displaced. However, because herbicides are used as an insurance against weeds, farmers routinely apply the preemergent product, before planting, without consideration of the postemergent product. Once a crop has been planted, the postemergent herbicide is used if necessary.

[19] *Chemical Marketing Reporter,* June 14, 1993, p. 1.

[20] Estimated by the staff of the U.S. International Trade Commission and the U.S. Environmental Protection Agency.

future. Since the dominant pesticide consumer is commercial agriculture, aggregate demand is strongly influenced by conditions in the farming community, primarily planted acreage, weather, and farm income.

In recent years, the more selective use of pesticides combined with new technology has helped stabilize aggregate commercial pesticide usage. One important technology is the development of lower-application pesticides. It is not unusual for some newer product application rates to be one or two ounces per acre, compared to application rates of several pounds per acre for the older products. This technology is well established in the insecticide market, and, to a lesser degree, in the herbicide market. Pesticide use has also declined as a result of improved pest management programs, better use information provided to farmers, and the government-sponsored alternative agriculture programs discussed below.

Government Policies Affecting Demand

Government policies can influence domestic pesticide consumption either indirectly, through agricultural programs such as price supports and acreage diversion programs, or directly, through pesticide regulation. During the 1980s, acreage diversion programs, such as the 1983 Payment in Kind (PIK) program and the 1985 Food Security Act, limited total acreage directly and pesticide use indirectly. In addition to formal legislative programs, the Government and the private sector have embarked on a number of alternative agriculture programs such as organic farming, low-input sustainable agriculture (LISA), and integrated pest management (IPM). In 1990, Federal funding for LISA programs was $40 million. While the verdict on the effectiveness of the various agricultural programs may not be unanimous, these programs have, nevertheless, the potential to limit future pesticide consumption.[21]

The second source of government influence is direct regulation. Although most agree that, since the 1950s, pesticide use has dramatically increased agriculture's output, many have expressed concern about the safety of pesticides. In the 1950s, the Delaney report emphasized the potential dangers of chemical residues on food (particularly in processed food), while in the 1960s, Rachel Carson's *Silent Spring* focused attention on the potential dangers of pesticides on the environment. Since then, concern has surfaced over the potential influence of pesticides on farm workers and ground water, increased cancer risks, and birth defects. Such concerns have increased pesticide regulation.

[21] For a favorable view, see the National Research Council (NRC), *Alternative Agriculture*, 1989. For a more cautious view, see *Alternative Agriculture, Scientists' Review*, Special Publication, No. 16, June 1990, Ames, Iowa, the Council for Agricultural Science and Technology (CAST) review of the NRC report.

The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)[22]

Pesticide regulation has undergone a number of modifications since its inception with the Insecticide Act of 1910. In 1947, the Federal Insecticide, Fungicide, and Rodenticide Act established a registration and labeling procedure. Regulatory functions of FIFRA were transferred to the U.S. Environmental Protection Agency (EPA) when the agency was created in December 1970. Throughout its history, FIFRA has been amended and required to review the efficacy and safety of the pesticides registered in the United States. The most recent amendment to FIFRA occurred in 1988 when the EPA was required to implement a 5-year program of pesticide reregistration. Approximately 25,000 products using 400 active ingredients were subject to reregistration following the 1988 FIFRA amendments. In addition, pesticide manufacturers are required to pay a (sometimes substantial) registration fee for each of its active ingredients and formulations to cover the cost of testing. On February 15, 1991, 4,500 pesticide registrations were canceled by the EPA after the manufacturers declined to pay the registration fees. Included in this number were 71 active ingredients. Although the EPA noted that a large percentage of the products were not used, the agency nevertheless was concerned about the loss of minor-use pesticide products and formulations, owing to the cost of reregistration. Although not resolved, this issue continued to be reviewed in the 103rd Congress.

102nd Congress: S. 898

This proposed legislation (the Circle of Poison Prevention Act of 1991) would prevent exporting from the United States any pesticide that has not been registered with the EPA (or its counterpart in any other OECD country). The purpose of the bill is to ensure the safety of the U.S. food supply with respect to imported foods to which pesticides may have been applied. However, some have expressed concern that (1) the bill does not preclude the possibility that unregistered pesticides coming from other countries will enter the U.S. food chain; (2) some products may be unregistered for reasons other than safety;[23] and (3) it imposes risk/benefit analysis to countries where circumstances may be very different from those in the United States.[24] Although the bill did not pass in the

[22] For a review of pest regulatory policy, see Craig Osteen and Philip I. Szmedra, *Agricultural Pesticides, Use Trends and Policy Issues* (Agricultural Economic Report Number 622), Economic Research Service, Sept. 1989, USDA, pp. 39-52.

[23] For example, a U.S. producer might manufacture a fungicide for bananas. However, since bananas aren't grown commercially in the continental United States, there is no need for an EPA registration.

[24] See testimony of the U.S. EPA, the USDA, and the Department of Health and Human Services before the Committee on Agriculture, Nutrition, and Forestry, U.S. Senate, Sept. 20, 1991.

101st nor the 102nd Congress, it is viewed as likely that it will be considered in future Congresses and it has the potential to restrict world consumption of U.S. pesticides. EPA has limited jurisdiction over pesticide exports, particularly concerning appropriate labeling; however, it currently cannot prohibit U.S. exports.[25]

103rd Congress: H.R. 872, S. 331, and H.R. 967

Congressman Waxman (Democrat, CA) and Senator Kennedy (Democrat, MA) introduced companion legislation (H.R. 872 and S. 331) entitled the Pesticide Food Safety Act of 1993 with the intent of amending the Federal Food, Drug, and Cosmetic Act and strengthening the EPA's authority to regulate pesticides and to set tolerances for food-use pesticides. In related legislation, Congressman Kiki de la Garza (Democrat, TX) introduced legislation concerning pesticide use on minor crops (H.R. 967). In response, the Administration, through the efforts of the EPA, Food and Drug Administration (FDA), and the U.S. Department of Agriculture (USDA), is preparing comparable legislation for 1994 that is also committed "to working with farmers, environmentalists, farmworker advocates, consumer groups, pesticide manufacturers, food processors and Congress to break the logjam which has delayed passage of strengthened pesticide and food safety laws for years."[26] Industry sources note that there appears to be considerable determination in Congress and the Administration to limit pesticide use. More specifics of the Administration's plans were made public in hearings before the Subcommittee on Health and the Environment, Committee on Energy and Commerce on September 21, 1993, and the Committee on Agriculture, U.S. House of Representatives, on September 22, 1993.[27] However, there continues to be differences among the various interests; and, to date, specific legislation has not been passed. Two of the more controversial provisions in the Administration's proposals are the elimination of the Delaney Clause and the elimination of economic benefits in determining whether a pesticide should be registered.

State regulations

Pesticide manufacturers are subject not only to Federal regulations but also to State regulations, which vary greatly in their control and compliance costs. Among the states with more stringent regulations is California. In 1986, California enacted Proposition 65 that, in part, (1) prevented the discharge of pesticide-contaminated material into the water system, (2) required appropriate warning labels for field workers and consumers, (3) allowed private parties, under certain conditions, to initiate lawsuits against violators, and (4) called for the development of a list of potentially carcinogenic products.[28] In 1990, a proposed State law, the "Environmental Protection Act of 1990" (Proposition 128 "Big Green") would have, among other things, denied State registration to pesticides registered for food use by the EPA but classified as "known" or "probable carcinogens," or to products listed in Proposition 65. Although Proposition 128 was rejected by California voters in the November 1990 election, it signaled the State's intent to enforce strict environmental standards. Other States, such as Florida, have followed California and restricted pesticide use prior to EPA restriction. Regulation may be further extended by a 1991 U.S. Supreme Court ruling that grants local jurisdictions the right to regulate local pesticide use.[29]

Summary

Future aggregate U.S. pesticide consumption, by quantity, is expected to increase modestly, because of a mature agricultural market and environmental concern that has led to lowered application rates and the development of alternative agricultural practices (such as low input sustainable agriculture (LISA) and conservation tillage practices). Further, concern about ground-water contamination may also limit the domestic use of certain pesticides, while environmental regulations may limit the number of pesticide products available. However, in dollar terms, the value of pesticide consumption is likely to increase somewhat more rapidly as prices increase to cover environmental compliance costs. The extent of future price increases is, however, open to question. Internationally, as the pesticide industry attempts to expand foreign sales, many developing countries may not be able to afford high-priced pesticides. Domestically, the relative lack of new products in development may convert the current proprietary products into future commodity products subject to more price competition. Despite the continued pressures of a mature market and environmental regulation, one analyst found the U.S. industry in 1992 was more profitable than its larger European counterpart.[30]

FOREIGN INDUSTRY PROFILE

It is generally agreed there are three major producing areas in the world—Europe, the United States, and Japan (when ranked by sales)—that are also the major consuming areas. The largest individual pesticide producing countries in Europe are Germany, Switzerland, the United Kingdom, and France. Of the largest companies in the world in 1989, 13 were American-based, 13 were European-based, and 11 were Japanese-based. The Japanese companies sell mainly in the Far East, while the U.S. and European

[25] *Chemical & Engineering News*, June 21, 1993, p. 28.

[26] EPA, FDA, and USDA Joint press release, June 25, 1993.

[27] Press release, Subcommittee on Health and the Environment, Committee on Energy and Commerce, U.S. House of Representatives, Feb. 4, 1993.

[28] *Chemical Week*, Sept. 1, 1993, p. 9.

[29] *Chemical Week*, June 16, 1993, p. 16.

[30] Report written by Wood Mackenzie, reviewed in the *European Chemical News*, May 17, 1993, p. 8.

companies are more worldwide in their scope. One analyst reports that the top 10 U.S. and European companies account for approximately 60 percent of world sales. Further, the same multinational companies that dominate the U.S. industry also dominate the European industry. Table 2 lists the largest U.S. and European companies and their 1989 sales split between Europe and the United States. These data include a substantial amount of cross licensing and distribution arrangements within the industry. The data presented in table 2 are considered indicative of the industry's structure during 1988-92.

European Product Distribution and Pricing

There are three types of distribution systems in Europe. The first system provides few middlemen and little technical support for the customer. This system, prevalent in the United Kingdom, is the least costly. A second system, prevalent in Germany, is quite costly and involves supplying abundant technical support to farm cooperatives. The third distribution system, a hybrid of the first two, is found in Spain and France, where the costs are lower than in Germany, but higher than in the United Kingdom. The third system has a large number of distribution channels, but disseminates less technical information. It is reported that with EC market integration, prices among the dominant European firms are beginning to converge, and distribution is becoming more consistent and similar to the methods found in France.

European Regulation

An important issue confronting the European pesticide industry is the development of a harmonized registration process for new pesticides. It appears likely that a European Union-wide (EU) registration process will be developed for the active ingredients, but nationally determined regulation processes will prevail for the formulated products.

The environmental "Green" movement has been very effective in generating concern for the environment, in general, and about the excessive uses of pesticides, in particular. There are further efforts throughout the EU to reduce the overall use of pesticides. These efforts have been detailed in the EU Commission's 1991 recommendations for reforming the Common Agriculture Policy (CAP). Further, the extent of potential regulation is indicated in an EU Commission discussion document aimed, in part, at achieving a degree of rural environmental management, which would allow biodiversity and natural habitats to be maintained.[31] To achieve this objective, the plan proposes, for all rural areas, a significant reduction of pesticide use per unit of land under production and the conversion of farms to alternative agriculture practices such as integrated pest management. In 1992, the European pesticide market declined by 13.5 percent, the first year the new CAP regulations were in force. In 1993, the pesticide market was expected to again decline by the same amount.[32]

Another issue concerning the European pesticide manufacturers is the need for patent term restoration for agrochemicals. The industry believes that the time necessary to obtain regulatory approval is so long that the time remaining on the life of the patent is insufficient to earn the necessary return on investment.

U.S. TRADE MEASURES

Tariff Measures

Table 3 provides the January 1, 1993, column 1-rates of duty, preferential rates of duty, and U.S. exports and imports for 1992 for each 8-digit Harmonized Tariff Schedule (HTS) provision covering pesticide active ingredients and their formulations.[33] In 1992, approximately 75 percent of products and formulations entered the United States subject to duty rates greater than 8 percent, and virtually all imports were subject to some MFN duty rate. The trade-weighted ad valorem equivalent in 1992 was 8.3 percent but the column 2 rates are significantly higher, at times combining a specific plus an ad valorem rate. However, there are significant unilateral trade preferences for Israel, Canada, and Generalized System of Preferences (GSP) and Caribbean Basin Economic Recovery Act (CBERA) countries, but imports from these countries do not represent a large portion of the total value of U.S. imports.

In addition, there have been a number of temporary duty suspensions for individual pesticide active ingredients (AIs). These suspensions reflect the presence of the many foreign-owned companies in the United States and the lack of comparable, domestically-available products, due to the technical specificity of the pesticide products.

Nontariff Measures

Neither surveyed industry sources, nor the 1992 National Trade Estimate report published by the Office of the United States Special Trade Representative, indicate any major nontariff measures affecting trade for pesticide products. Some industry analysts note that the high cost of regulatory compliance in the United States could act as a nontariff barrier. However, since they are not applied preferentially against foreign imports, they are not considered to be true international barriers to trade.

There have been few classification criteria adjustments, or substantive changes that have affected pesticide products and formulations as a result of the conversion from the Tariff Schedules of the United States (TSUS) to the HTS. The U.S. Customs Service has made only a few classification decisions for pesticide products and formulations within the last 5 years.

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[31] *European Chemical News*, Feb. 24, 1992, p. 17.

[32] John McDougal of Wood Mackenzie, reported in *Chemical Week*, Sept. 8, 1993, p. 24.

[33] See app. A for an explanation of tariff and trade agreement terms.

Table 3
Pesticide products and formulations: Harmonized Tariff Schedule subheading; description; U.S. col. 1 rate of duty as of Jan. 1, 1993; U.S. exports, 1992; and U.S. imports, 1992

HTS subheading	Description	Col. 1 rate of duty as of Jan. 1, 1993		U.S. exports, 1992	U.S. imports, 1992
		General	Special[1]	— Million dollars —	
2903.59.10	Halogenated pesticides derived in whole or in part from benzene or other aromatic hydrocarbon, nesoi	12.5%	Free (A,CA,E,IL,J)		5
2903.69.30	Pesticides made of halogenated derivatives of aromatic hydrocarbons, nesoi	12.5%	Free (A,CA,E,IL,)		0
2908.10.20	Pentachlorophenol and its salts; and 2,4,5-Trichlorophenol and its salts	11.1%	Free (A,CA,E,IL,J)	1	1
2909.30.30	Pesticides of aromatic ethers and their halogenated, sulfonated, nitrated or nitrosated derivatives	13.1%	Free (A,CA,E,IL,J)		0
2918.90.10	Specified aromatic pesticides derived from carboxylic acids with additional oxygen function, and their derivatives	6.8%	Free (A,CA,E,IL,J)		17
2918.90.20	Other aromatic pesticides, nesoi	13.5%	Free (A,CA,E,IL,J)	14	40
2920.10.10	0,0-Dimethyl-0-(4-nitro-m-tolyl)-phosphorothioate (Fenitrothion)	6.8%	Free (A,CA,E,IL,J)		1
2920.90.10	Aromatic pesticides of esters of other inorganic acids (excluding hydrogen halides), their salts and their derivatives	12.5%	Free (A,CA,E,IL,J)		1
2924.21.10	Specified aromatic pesticides of ureines (monuron and fluometuron)	6.8%	Free (A,CA,E,IL,J)		0
2924.21.15	Aromatic pesticides of ureines and their derivatives; salts thereof, nesoi	13.5%	Free (A,CA,E,IL,J)		32
2924.29.15	Specified aromatic pesticides of aromatic cyclic amides (including cyclic carbamates) and their derivatives; salts thereof	6.8%	Free (A,CA,E,IL,J)		8
2924.29.19	Aromatic pesticides of cyclic amides (including cyclic carbamates) and their derivatives, salts thereof, nesoi	12.9%	Free (A,CA,E,IL,J)		147
2926.90.21	Aromatic fungicides of nitrile-function compounds	11.1%	Free, (A,CA,E,IL,J)		2
2926.90.23	3,5-Dibromo-4-hydroxybenzonitrile (Bromoxynil)	6.8%	Free (A,CA,E,IL,J)		17
2926.90.25	Aromatic herbicides of nitrile-function compounds, nesoi	13.5%	Free (A,CA,E,IL,J)		2
2926.90.27	Aromatic pesticides of nitrile-function compounds, nesoi	12.5%	Free (A,CA,E,IL,J)		22
2930.20.10	Aromatic pesticides of thiocarbamates and dithiocarbamates	13.5%	Free (A,CA,E,IL,J)	1	0
2930.90.10	Other aromatic organo-sulfur pesticides used as pesticides	12.5%	Free (A,CA,E,IL,J)	85	21
2930.90.30	Thiocyanates, thiurams and isothiocyanates	3.7%	Free (A,CA,E,IL,J)		7
2930.90.35	Nonaromatic pesticides of organo-sulfur compounds, nesoi	7.9%	Free (A,CA,E,IL,J)		83
2931.00.25	Pesticides of aromatic organo-inorganic (except organo-sulfur) compounds	11.1%	Free (A,CA,E,IL,J)	33	6
2932.29.10	Aromatic pesticides of lactones	12.5%	Free (A,CA,E,IL,J)	1	1
2932.90.10	2,2-Dimethyl-1,3-benzodioxol-4-yl methylcarbamate (Bendiocarb); and 2-Ethoxy-2,3-dihydro-3,3-dimethyl-5-benzofuranylmethanesulfonate	6.8%	Free (A,CA,E,IL,J)	4	4
2932.90.20	Aromatic pesticides of heterocyclic compounds with oxygen hetero-atom(s) only, nesoi	11.1%	Free (A,CA,E,IL,J)		1
2933.19.25	Aromatic or modified aromatic pesticides of heterocyclic compounds with nitrogen hetero-atom(s) only, cont. unfused pyrazole ring	13.5%	Free (A*,CA,E,IL,J)		3
2933.39.21	Fungicides of heterocyclic compounds with nitrogen hetero-atom(s) only, containing an unfused pyridine ring	11.1%	Free (A,CA,E,IL,J)		4
2933.39.23	o-Paraquat dichloride	6.8%	Free (A,CA,E,IL,J)		
2933.39.25	Herbicides of heterocyclic compounds with nitrogen hetero-atom(s) only, containing an unfused pyridine ring, nesoi	13.5%	Free (A*,CA,E,IL,J)		14
2933.39.27	Pesticides of heterocyclic compounds with nitrogen hetero-atom(s) only, containing an unfused pyridine ring, nesoi	12.5%	Free (A,CA,E,IL,J)		1

See footnotes at end of table.

Table 3—*Continued*

Pesticide products and formulations: Harmonized Tariff Schedule subheading; description; U.S. col. 1 rate of duty as of Jan. 1, 1993; U.S. exports, 1992; and U.S. imports, 1992

HTS subheading	Description	Col. 1 rate of duty as of Jan. 1, 1993		U.S. exports, 1992	U.S. imports, 1992
		General	Special[1]	— *Million dollars* —	
2933.40.30	Pesticides of heterocyclic compounds with nitrogen hetero-atom(s) only, cont. a quinoline or isoquinoline ring-system, not further fused	11.1%	Free (A,CA,E,IL,J)	1	1
2933.59.10	Aromatic or modified aromatic herbicides of heterocyclic compounds with nitrogen hetero-atom(s) only, cont. a pyrimidine or piperazine ring	13.5%	Free (A,CA,E,IL,J)	22	1
2933.59.15	Aromatic or modified aromatic pesticides of heterocyclic compounds with N-hetero-atom(s) only, cont. a pyrimidine or piperazine ring, nesoi	12.5%	Free (A,CA,E,IL,J)		4
2933.59.18	Nonaromatic pesticides of heterocyclic compounds with nitrogen hetero-atom(s) only, cont. pyrimidine or piperazine ring, nesoi	7.9%	Free (A,CA,E,IL,J)		7
2933.90.15	5-Amino-4-chloro-alpha-phenyl-3-pyridazinone; and o-Diquat dibromide (1,1'-ethylene-2,2'-dipyridylium dibromide)	6.8%	Free (A,CA,E,IL,J)		2
2933.90.18	Aromatic or modified aromatic insecticides of heterocyclic compounds with nitrogen hetero-atom(s) only, nesoi	12.5%	Free (A,CA,E,IL,J)	33	22
2933.90.20	Aromatic or modified aromatic pesticides of heterocyclic compounds with nitrogen hetero-atom(s) only, nesoi	13.5%	Free (A,CA,E,IL,J)		55
2934.20.35	Pesticides containing a benzothiazole ring-system, not further fused	11.1%	Free (A,CA,E,IL,J)		0
2934.90.10	Specified aromatic or modified aromatic heterocyclic pesticide compounds, nesoi	6.8%	Free (A,CA,E,IL,J)		71
2934.90.12	Aromatic or modified aromatic fungicides of other heterocyclic compounds, nesoi	11.1%	Free (A,CA,E,IL,J)		11
2934.90.14	Aromatic or modified aromatic herbicides of other heterocyclic compounds, nesoi	13.5%	Free (A,CA,E,IL,J)		2
2934.90.16	Aromatic or modified aromatic insecticides of other heterocyclic compounds, nesoi	12.5%	Free (A,CA,E,IL,J)		1
2934.90.18	Aromatic or modified aromatic pesticides of other heterocyclic compounds, nesoi	10.7%	Free (A,CA,E,IL,J)		1
3808.10.10	Fly ribbons (ribbon fly catchers), put up in packings for retail sale	2.8%	Free (A,CA,E,IL,J)		1
3808.10.20	Insecticides, nesoi, containing any aromatic or modified aromatic insecticides, put up for retail sale or as preparations or articles	1.8¢/kg + 9.7%	Free (A,CA,E,IL,J)		3
3808.10.30	Insecticides, nesoi, containing an inorganic substance, put up for retail sale	5%	Free (A,CA,E,IL,J)		8
3808.10.50	Insecticides, nesoi, for retail sale or as preparations or articles	5%	Free (CA,E,IL,J)		13
3808.20.10	Fungicides, nesoi, containing any aromatic or modified aromatic fungicides put up for retail sale or as preparations or articles	1.8¢/kg + 9.7%	Free (A,CA,E,IL,J)		14
3808.20.20	Fungicides, nesoi, which contain thioamide, thiocarbamate, dithiocarbamate, thiuram, or isothiocyanate, put up for retail sale	3.7%	Free (A,CA,E,IL,J)		32
3808.20.30	Fungicides, neosi, containing an inorganic substance, put up for retail sale	5%	Free (A,CA,E,IL,J)		4
3808.20.50	Fungicides, nesoi, put up in forms or packing for retail sale or as preparations or articles	5%	Free (A,CA,E,IL,J)		4

See footnotes at end of table.

Table 3—*Continued*
Pesticide products and formulations: Harmonized Tariff Schedule subheading; description; U.S. col. 1 rate of duty as of Jan. 1, 1993; U.S. exports, 1992; and U.S. Imports, 1992

HTS subheading	Description	Col. 1 rate of duty as of Jan. 1, 1993		U.S. exports, 1992	U.S. Imports, 1992
		General	Special[1]		
				— *Million dollars* —	
3808.30.10	Herbicides, antisprouting products and plant-growth regulators, aromatic or modified aromatic, for retail sale	1.8¢/kg + 9.7%	Free (A,CA,E,IL,J)		107
3808.30.20	Herbicides, antisprouting products and plant-growth regulators, nesoi, containing an inorganic substance, for retail sale	5%	Free (A,CA,E,IL,J)		1
3808.30.50	Herbicides, antisprouting products and plant-growth regulators, nesoi, put up for retail sale	5%	Free (E,CA,IL,J)		7
3808.40.10	Disinfectants, containing any aromatic or modified aromatic disinfectant	1.8¢/kg + 9.7%	Free (A*,CA,E,IL,J)		1
3808.40.50	Disinfectants, nesoi	5%	Free (A,CA,E,IL,J)		1
3808.90.10	Pesticides, nesoi, containing any aromatic or modified aromatic pesticides	1.8¢/kg + 9.7%	Free (A,CA,E,IL,J)		4
3808.90.20	Pesticides and similar products, nesoi, containing an inorganic substance	5%	Free (A,CA,E,IL,J)		33
3808.90.50	Pesticides and similar products, nesoi	5%	Free (CA,E,IL,J)		10

[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); Automotive Products Trade Act (B); Agreement on Trade in Civil Aircraft (C); United States-Canada Free-Trade Agreement (CA); Caribbean Basin Economic Recovery Act (E); Andean Trade Preference Act (J); and United States-Israel Free Trade Area (IL)

[2] In general, Schedule B classifications are not as detailed as import HTS classifications. Therefore, the export data reported in this table refer only to Schedule B numbers that are specific to pesticide products and formulations. Chemically defined Schedule B basket categories that include pesticides products are excluded. For further discussion, see introductory paragraph in "U.S. Consumption" section of report. Except where specifically listed, export data at this level of aggregation are not available.

Source: U.S. exports and imports compiled from official statistics of the U.S. Department of Commerce.

In March 1990, a petition was filed with the Commission under section 337 of the Tariff Act of 1930, (19 U.S.C. 1337) relating to certain pyrethroids and pyrethroid-based insecticides. On May 8, 1990, the investigation was terminated when all private parties in the investigation accepted a settlement agreement.

FOREIGN TRADE MEASURES

The primary markets for U.S. pesticide products and formulations are the EU, Canada, and Japan. Canada sets forth five columns of tariff treatment, three of which are relevant to this summary:[34] The Most Favored Nation tariff (MFN) rates, the U.S.-Canada Free-Trade Agreement rates, and the General Preferential Tariff (GPT) rates for developing countries. The U.S.-Canada Free-Trade Agreement (CFTA), which entered into force in 1989, provides for the elimination of duties over a 10-year transition period on U.S.-origin goods imported into Canada. Preferential 1992 duties for U.S. pesticide products and formulations range from free to 10 percent ad valorem. The MFN tariff rates in Canada for these products range from free to 12.5 percent, with a substantial portion of pesticide products having the higher rates and formulations having the free and lower rates. However, GPT rates are, in most cases, currently between the U.S. and MFN rates, ranging from free to 8 percent ad valorem. Canada has two other special rates: the British Preferential Tariff (BPT) rates, which apply to developing countries that are members of the British Commonwealth and to Australia and New Zealand, and the Least Developed Developing Country rates, which apply to countries identified as such by the United Nations.

Pesticide products and formulations entering Japan are subject to four possible rates—the General, the MFN, Preferential, and a Temporary rate.[35] General rates for these products range from free to 20 percent ad valorem, with a large portion of the rates being 20 percent. Imports entering under GATT rates range from free to 5.8 percent ad valorem, but most of them range from 4.6 to 5.8 percent ad valorem. Products enter duty free under the Preferential rates whereas Temporary rates are slightly less than or equal to the GATT rate. The Temporary rates apply to products imported from the United States.

All EU imports are subject to two classification rates—conventional and autonomous.[36] In addition, a large number of unilateral trade preferences to developing countries are presented as duty-free imports, with limitations to these preferences defined by quotas. If a developing country exceeds its quota, a member country may object, at which time continued importation is subject to the conventional rate. If no country objects, the developing country can continue to export to the EU duty free. In general, EU imports of pesticide products and formulations are subject to rates ranging from 5.5 percent to 14 percent ad valorem under the conventional rate.

[34] U.S. Department of Commerce Canada country desk staff and relevant portions of the headnotes to the *Canadian Tariff Schedule, 1991*.

[35] U.S. Department of Commerce Japan country desk staff and relevant portions of the headnotes to the *Customs Tariff Schedules of Japan, 1991*.

[36] U.S. Department of Commerce, European Community desk staff and relevant portions of the EC Journal.

U.S. MARKET

Consumption

Due to allocation changes that occurred during the 1988 conversion from the Tariff Schedules of the United States (TSUS) to the Harmonized Tariff Schedule (HTS), the pre-1989 export and import data are not consistent with comparable data for 1989-92. Consequently, this summary will use government data from the period 1989-92 when discussing the value of apparent consumption, imports, and exports.

Furthermore, among the U.S. Schedule B export classifications (both TSUS-based and HS-based), chemicals are often aggregated under residual (basket) categories determined by chemical structure rather than end use. As a consequence, it is likely that many of these basket items obscure the end-use distribution of some chemical exports.[37][38] The Census-based export data (reported in dollars, table 4) used in this report reflect only exports for specifically enumerated pesticide classifications, with no attempt to estimate end-use allocations for basket categories. Therefore, the dollar export values in table 4 are likely to be understated, and apparent consumption values overstated. For an alternative presentation of recent trends, this table has been expanded into four tables (tables 4a-4d) using quantity data for total pesticides, herbicides, insecticides, and fungicides collected by the National Agricultural Chemicals Association (NACA).[39]

In current dollars,[40] aggregate U.S. pesticide consumption decreased 7 percent, from $3,973 million in 1989 to $3,695 million in 1992. Many industry analysts believe that this decrease reflects fluctuations in demand. They note that, since the early 1980s, the

[37] In part, because of recent concern about U.S. pesticide exports, this summary has discussed, in some detail, the inherent problems with export data.

[38] For example, the import-based HTS item for 2903.59.10 refers to certain halogenated hydrocarbon pesticides. There is no corresponding Schedule B subheading, only the item 2903.59.00, which is a basket category for certain cyclic halogenated hydrocarbons.

[39] The production, import, export, and apparent consumption data are obtained from annual surveys sponsored by the National Agricultural Chemicals Association.

[40] Current dollars (as apposed to constant dollars) notes that the value of the trade data has not been adjusted to account for inflation during the period in question.

growth trend has been flat. During 1988-92, NACA data show that aggregate U.S. consumption of pesticide products, by quantity, decreased 8 percent from 944 million pounds in 1988 to 864 million pounds in 1992, with a 1-year increase in 1989 (table 4a).

During 1988-92, agriculture was the major consumer of pesticides, accounting for approximately 75 percent of U.S. consumption. Since agriculture grew modestly during this period, fluctuating with planted acreage, the weather, government regulatory programs, and more effective low-dose products, aggregate pesticide consumption for many products reflected these conditions in the agriculture market.

By Major End-Use Markets

Within the agriculture market, corn, soybeans, cotton, small grains, and fruits and vegetables accounted for approximately 70 percent of aggregate U.S. pesticide consumption. Corn has the largest planted acreage in the United States and, in turn, receives the largest amount of pesticides, including herbicides, insecticides, and fungicides. Approximately 90 percent of corn acreage is treated with herbicides, 50 percent is treated with insecticides, and 85 percent with fungicides. Only 40 years ago, less than 12 percent of total corn acreage was treated with herbicides. Corn acreage, which averaged between 60 and 70 million acres in recent years, accounted for 40 percent of aggregate pesticide consumption and 60 percent of herbicide consumption.

Soybeans were the second largest consumer of pesticides during the period, consuming primarily herbicides and insecticides. Soybeans have also been the fastest growing crop since the 1970s, planted primarily in the Midwest and the Southeast and accounting for approximately 20 percent of total pesticide consumption. In 1991, 58 to 60 million acres were planted in soybeans, using 100 million pounds of herbicides and 10 million pounds of insecticides.

Cotton has been the third largest sub-market for pesticides in recent years. In 1990, cotton agriculture consumed approximately 38 to 40 million pounds of pesticides divided equally between herbicides and insecticides. More than 90 percent of cotton acreage is treated with both herbicides and insecticides. Because cotton is grown in a variety of climates and regions, it is subject to a wide variety of pesticide products.

Table 4
Pesticide products and formulations: U.S. total shipments, exports of domestic merchandise, imports for consumption, and apparent consumption, 1988-92

Year	U.S. shipments[1]	U.S. Exports	U.S. Imports	Apparent U.S. consumption	Ratio of imports to consumption
	Million dollars				*Percent*
1988	4,345	1,362	553	3,536	15.6
1989	4,655	1,327	645	3,973	16.2
1990	4,582	1,342	643	3,883	16.6
1991	4,019	1,253	670	3,436	19.5
1992	4,176	1,279	798	3,695	21.6

[1] U.S. shipments data obtained from the annual USITC publication, *Synthetic Organic Chemicals, United States Production and Sales.* Furthermore, these data refer to total U.S. shipments, which include both domestic sales and exports. However, U.S. shipments data on tables 4a-4d refer only to domestic shipments (excluding export sales) and are noted as such. Finally, U.S. shipments data in this table refer only to pesticide products (e.g. active ingredients), while export and import data include both pesticide products and formulations. In tables 4a-4d, all data refer to quantity and only to pesticide products. Those tables are noted as such.

Source: Compiled from official statistics of the U.S. Department of Commerce, except as noted.

Table 4a
Pesticide products: U.S. domestic shipments, exports of domestic merchandise, imports for consumption, and apparent consumption, 1988-92

Year	U.S. domestic shipments[1]	U.S. Exports	U.S. Imports	Apparent U.S. consumption	Ratio of imports to consumption
	Million pounds				*Percent*
1988	804	378	140	944	14.8
1989	885	381	143	1,028	13.9
1990	754	333	132	886	14.9
1991	721	332	129	850	15.2
1992	732	352	132	864	15.3

Source: Compiled from statistics of the National Agricultural Chemicals Association.

Fruits, nuts, and vegetables constitute the fourth largest sub-market for U.S. pesticides, with total 1990 pesticide consumption valued at approximately $370 million. Expenditures for insecticides were about $150 million; expenditures for herbicides, approximately $90 million; and expenditures for fungicides, approximately $105 million. Fruits, nuts, and vegetables represent the largest market for fungicides. Other significant sub-markets, comprising the remaining 30 percent of pesticide consumption, include peanut and tobacco for fungicides, and sorghum and rice for the herbicides.

By Major Pesticide Category

The approximate annual U.S. distribution of pesticide consumption, by pesticide category and by percentage of value during 1988-92, is indicated in the following tabulation:[41]

Herbicides	53%
Insecticides	29%
Fungicides	11%
Other	7%

[41] Arnold L. Aspelin, Arthur H. Grube, and Robert Torla, *Pesticides Industry Sales and Usage, 1990 and 1991 Market Estimates,* U.S. Environmental Protection Agency, Fall 1992, p. 6.

The quantity of U.S. herbicide consumption, the largest selling category of pesticides in the United States and in the world, increased 4 percent from 1988 to 1992, with a large increase in 1989 (table 4b). Consumption was influenced by weather conditions, such as the drought in 1988.

U.S. consumption of insecticides decreased almost 14 percent from 144 million pounds in 1988 to 124 million pounds in 1991, only to increase to 134 million pounds in 1992 (table 4c). Since the late 1970s, there has been a slow, but steady, decline in the use of insecticides, reflecting an increased use of integrated pest management procedures, better monitoring, reduced application per year, more effective products requiring smaller applications, and reduced planted acreage in some major insecticide-using crops.

The quantity of U.S. fungicide consumption increased from 189 million pounds in 1988 to 203 million pounds in 1989, and then decreased to 158 million pounds in 1990 (table 4d). The fluctuations were influenced by environmental standards causing the withdrawal of certain products from the market and changes in planted acreage among the primary crops using fungicides. Tobacco acreage decreased during the period, but certain fruits and vegetable acreage increased. Overall fungicide-treated acreage increased somewhat during the period as rice and soybean acreage increased.

Table 4b
Herbicide products: U.S. domestic shipments, exports of domestic merchandise, imports for consumption, and apparent consumption, 1988-92

Year	U.S. domestic shipments[1]	U.S. Exports	U.S. Imports	Apparent U.S. consumption	Ratio of imports to consumption
	Million pounds				*Percent*
1988	437	239	79	516	15.3
1989	476	236	86	562	15.3
1990	437	207	83	520	15.8
1991	442	216	85	527	16.1
1992	459	237	78	537	14.5

Source: Compiled from statistics of the National Agricultural Chemicals Association.

Table 4c
Insecticide products: U.S. domestic shipments, exports of domestic merchandise, imports for consumption, and apparent consumption,

Year	U.S. domestic shipments[1]	U.S. Exports	U.S. Imports	Apparent U.S. consumption	Ratio of imports to consumption
	Million pounds				*Percent*
1988	120	83	24	144	16.7
1989	115	86	20	135	14.8
1990	109	82	16	125	12.8
1991	108	73	16	124	12.9
1992	114	76	20	134	14.9

Source: Compiled from statistics of the National Agricultural Chemicals Association.

Table 4d
Fungicide products: U.S. domestic shipments, exports of domestic merchandise, imports for consumption, and apparent consumption, 1988-92

Year	U.S. domestic shipments[1]	U.S. Exports	U.S. Imports	Apparent U.S. consumption	Ratio of imports to consumption
	Million pounds				*Percent*
1988	159	34	30	189	15.8
1989	175	35	28	203	13.8
1990	134	31	24	158	15.2
1991	(1)	29	26	(2)	(2)
1992	(1)	27	32	(2)	(2)

1 Not shown to avoid disclosure of individual company data.
2 Not available.

Source: Compiled from statistics of the National Agricultural Chemicals Association.

Production

The current dollar value of U.S. aggregate shipments of pesticide products and formulations declined (with fluctuation) 10 percent from $4,655 million in 1988 to $4,176 million in 1992 (table 4). In terms of quantity (table 4a), aggregate shipments of pesticide products (for domestic use and export) declined some 8 percent from 1,182 million pounds in 1988 to 1,084 million pounds in 1992, with a 1-year increase in 1989. Domestic production destined for export markets during 1988-92 decreased (with some variation). Domestic production for exports equaled almost half of the production destined for U.S. consumption.

Imports

Products imported, principal import suppliers, and U.S. importers

The largest category of imported pesticides in 1992 (by quantity) was herbicides, accounting for 60 percent of total imports, followed by fungicides (24 percent) and then by insecticides (15 percent). These proportions are generally representative of the whole period under study. Industry analysts note that a substantial portion of these imported products were intracompany sales, with Germany, Switzerland, the United Kingdom, and Japan as the principal import suppliers. In recent years, Brazil has emerged as a prominent supplier. However, given the presence of foreign multinational companies (both U.S. and European) in Brazil, it is difficult to determine what portion of these products are from Brazilian national companies. Industry analysts note that a number of pesticides are or will be going off-patent in the 1990s. At that time, developing countries will more likely become true exporting countries, specializing in generic, off-patent products. Eastern Europe has the potential to be a large exporter of generic products, but analysts believe a large portion of Eastern European exports will be destined for Europe and Africa.

U.S. importers are typically either large multinational pesticide companies or pesticide formulators and distributors. The larger companies import active ingredients from foreign affiliates for formulation and sales in the United States. Independent formulators and distributors, on the other hand, are likely to import truly foreign products. These products can be either off-patent products produced overseas generically or products sold directly to U.S. distributors by foreign companies.

Import levels and trends

In current dollars, imports of pesticide products and formulations, increased approximately 24 percent, from $645 million in 1989 to $798 million in 1992 (table 5). By quantity, pesticide product and formulation imports increased 9 percent, from 122 million kilograms in 1989 to 133 million kilograms in 1992. However, NACA data show that, over the same period, imports of pesticide products decreased in absolute terms while increasing in the share of apparent consumption during this period. The imports-to-consumption ratio increased from 14.8 percent in 1988 to 15.3 percent in 1992 (table 4a). Approximately 15 percent of imported pesticide products and formulations enter the United States duty free under either the United States-Israel Free Trade Implementation Act of 1985, the GSP, or the CBERA. Brazil was the chief GSP supplier in 1992. Finally, a number of products have entered the United States duty free under temporary duty suspensions.

FOREIGN MARKETS

Foreign Market Profile

After increasing slowly, but steadily, world consumption of pesticides, in current dollars, grew from some $20 billion in 1988 to almost $27 billion in 1991; world consumption then decreased to slightly more than $26 billion in 1992. Moderate increased consumption in the United States and certain Pacific markets, in addition to increased world cotton acreage, offset the decreased European pesticide consumption (particularly in Northern Europe).

Table 5
Pesticide products and formulations: U.S. imports for consumption, by principal sources, 1988-92

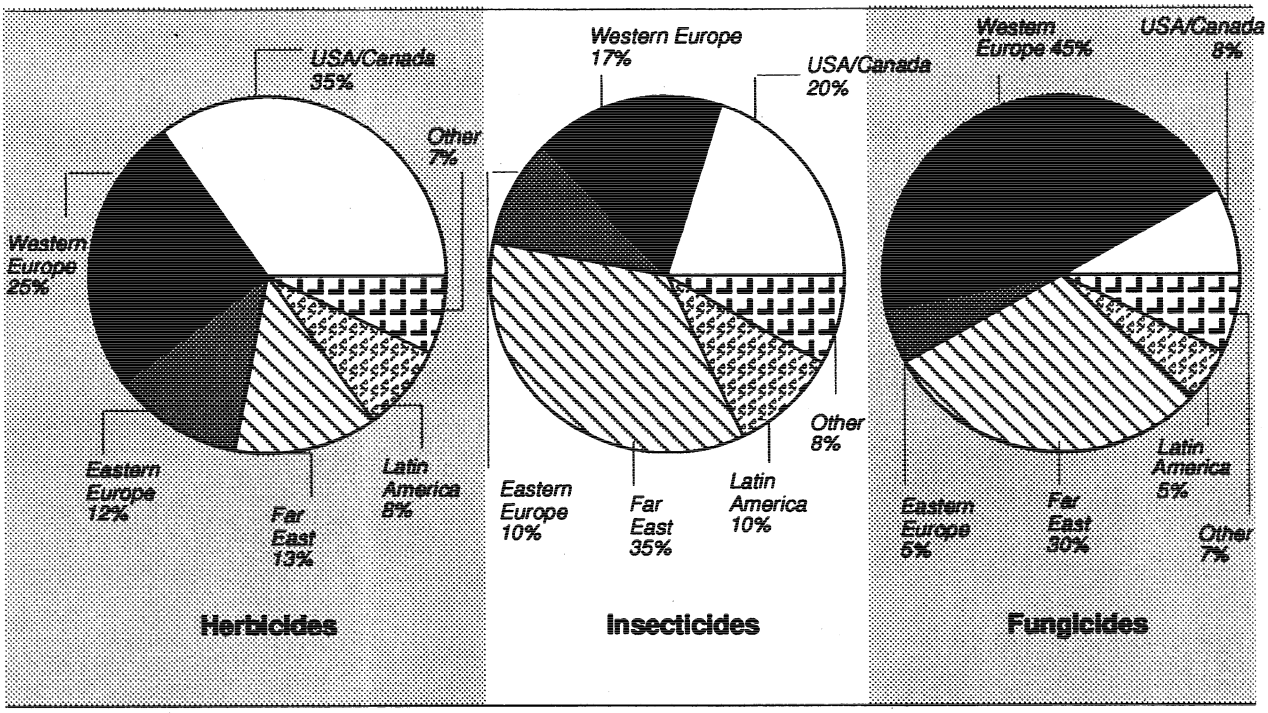
Source	1988	1989	1990	1991	1992
			Quantity *(1,000 kilograms)*		
Switzerland	(1)	32,247	31,482	28,423	33,509
United Kingdom	(1)	12,068	10,607	10,231	13,115
Germany	(1)	18,606	12,976	12,885	11,766
Japan	(1)	3,019	3,694	3,356	4,628
Brazil	(1)	8,188	8,892	9,013	11,535
France	(1)	6,082	6,832	8,076	9,312
Israel	(1)	3,269	4,358	6,340	4,088
Canada	(1)	2,604	3,700	5,007	6,885
Netherlands	(1)	5,479	5,773	4,913	5,258
All other	(1)	30,933	33,066	26,495	33,296
Total	110,721	122,494	121,380	114,738	133,391
			Value *(1,000 dollars)*		
Switzerland	(1)	125,309	127,282	118,084	152,429
United Kingdom	(1)	93,104	90,541	102,960	140,253
Germany	(1)	130,427	108,026	114,586	114,578
Japan	(1)	46,208	59,239	63,489	94,495
Brazil	(1)	56,753	38,648	57,201	55,529
France	(1)	29,801	36,704	38,133	39,805
Israel	(1)	29,135	35,881	41,964	32,802
Canada	(1)	11,840	17,966	21,772	31,388
Netherlands	(1)	17,019	23,427	17,229	24,493
All other	(1)	105,824	104,963	94,619	112,142
Total	552,728	645,418	642,678	670,039	797,914
			Unit value *(Dollars per kilograms)*		
Switzerland	(1)	3.89	4.04	4.15	4.55
United Kingdom	(1)	7.71	8.54	10.06	10.69
Germany	(1)	7.01	8.32	8.89	9.74
Japan	(1)	15.31	16.04	18.92	20.42
Brazil	(1)	6.93	4.35	6.35	4.81
France	(1)	4.90	5.37	4.72	4.27
Israel	(1)	8.91	8.23	6.62	8.02
Canada	(1)	4.55	4.86	4.35	4.56
Netherlands	(1)	3.11	4.06	3.51	4.66
All other	(1)	3.42	3.17	3.57	3.37
Average	4.99	5.27	5.29	5.84	5.98

1 Import values are provided only for years in which there are actual trade data based on the Harmonized Tariff Schedule of the United States (HTS).

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

The approximate average annual distribution of pesticide consumption by geographic area is presented in figure 2. Western Europe and USA/Canada are the largest consumers of herbicides; the Far East and USA/Canada are the largest consumers of insecticides; while the Far East and Western Europe are the largest consumers of fungicides. During the 1970s and 1980s, there was a boom in EU agriculture, stimulated in part by the EU's Common Agriculture Policy (CAP). Under this policy, the EU countries provide price supports for certain agriculture products, thereby stimulating agriculture production and pesticide consumption. As surplus stores of agricultural products increased in the early 1980s, the EU began to reduce the level of price support, thus limiting agriculture output and the need for pesticide products. In addition, the EC is facing the same regulatory and environmental challenges that are occurring in the United States. Finally, most of the major multinational producers are headquartered in Europe, thereby making the market very competitive. These three factors have induced many large U.S. manufacturers to locate some of their productionand/or research facilities in Europe to become part of the EU.

Figure 2
Average annual consumption of pesticide products by geographic region, 1988–92



Source: Compiled by the staff of the U.S. International Trade Commission from various sources.

The former Soviet Union and Eastern Europe were relatively small markets for pesticides during the period. Furthermore, weather, currency, and distribution problems made these markets unstable. Although analysts expect that recent political changes will increase future sales, they note that many of these countries not only have pesticide technology, but also they have been producing the older products for years. Finally, because they have less restrictive environmental regulations, they more readily accept foreign generic products.

Although the Pacific area is a large and growing consuming area—particularly Japan, Australia, New Zealand, and Korea—Japanese and European companies have strong positions in these markets. Developing countries throughout the world represent the largest potential market for future pesticide sales. As some of these countries either increase their internal need for food or use food as a major export product (as in Latin America), pesticide consumption is expected to increase. Although developing countries represent large pesticide markets, many of these countries are developing the technology to manufacture their own products. In addition, many multinational companies have expressed concern about the illegal manufacture of patented products in some developing countries.

U.S. Exports

Products exported and U.S. exporters

During 1988-92, U.S. pesticide producers exported approximately 45 percent of what they sold in domestic markets, amounting to some 352 million pounds in 1992 (table 4a). Although pesticides are exported by many U.S. companies, the larger companies, having the financial resources to meet distribution and international regulation costs, have an advantage in exporting. For smaller companies, exporting off-patent products or exporting to countries with less restrictive regulations are preferable alternatives.

The large share of exports to major markets often reflects intra-company sales of the larger multinational companies. Therefore, these numbers may not accurately reflect the U.S. presence in world markets either to the extent that U.S. companies have production facilities in Europe or to the extent that European companies are importing product from their U.S. facilities. Although herbicides have been the largest group of U.S. exported pesticide products, the U.S. industry exports virtually all pesticide products with the destination for specific products being

Table 6
Pesticide products and formulations: U.S. exports of domestic merchandise, by principal markets, 1988-92

Market	1988	1989	1990	1991	1992
			Quantity *(1,000 kilograms)*		
Canada	(1)	74,686	96,059	87,339	94,123
Japan	(1)	11,456	11,715	13,289	14,623
Belgium	(1)	23,280	22,073	11,301	13,524
France	(1)	12,486	12,534	10,579	10,482
Netherlands	(1)	8,882	10,701	7,679	6,047
Australia	(1)	10,407	5,069	3,429	7,005
United Kingdom	(1)	5,127	3,030	3,495	15,008
Mexico	(1)	7,236	8,267	11,153	8,420
Brazil	(1)	4,817	4,475	7,392	6,861
All other	(1)	110,932	160,186	82,782	103,212
Total	219,903	269,309	334,109	238,439	279,304
			Value *(1,000 dollars)*		
Canada	(1)	190,277	285,261	272,388	278,015
Japan	(1)	115,436	107,107	142,587	144,568
Belgium	(1)	143,666	158,478	105,855	91,144
France	(1)	62,478	80,946	42,874	60,095
Netherlands	(1)	53,654	121,412	90,140	46,695
Australia	(1)	76,576	35,021	29,331	45,911
United Kingdom	(1)	43,775	25,358	37,613	43,359
Mexico	(1)	35,567	37,814	45,499	42,305
Brazil	(1)	38,936	31,318	54,129	42,160
All other	(1)	566,180	459,724	432,486	484,577
Total	1,361,540	1,326,546	1,342,439	1,252,902	1,278,829
			Unit value *(Dollars per kilograms)*		
Canada	(1)	2.55	2.97	3.12	2.95
Japan	(1)	10.08	9.14	10.73	9.89
Belgium	(1)	6.17	7.18	9.37	6.74
France	(1)	5.00	6.46	4.05	5.73
Netherlands	(1)	6.04	11.35	11.74	7.72
Australia	(1)	7.36	6.91	8.55	6.55
United Kingdom	(1)	8.54	8.37	10.76	2.89
Mexico	(1)	4.91	4.57	4.08	5.02
Brazil	(1)	8.08	7.00	7.32	6.14
All other	(1)	5.10	2.87	5.22	4.69
Average	6.19	4.93	4.02	5.25	4.58

[1] Country detail provided only for years in which there are actual trade data based on the Harmonized Tariff Schedule

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

determined by the indigenous crops of the importing countries.

Export levels and trends

During 1989-92, exports of pesticide products and formulations, in current dollars, decreased slightly, from $1,327 million in 1989 to $1,279 million in 1992, while the quantity of exports fluctuated between 269 million kilograms in 1989 and 279 million kilograms in 1992 (table 6). NACA data showed that, by quantity, exports of pesticide products declined, with some fluctuation, from 378 million pounds in 1988 to 352 million pounds in 1992 (table 4a). Within this aggregate group, herbicide exports remained basically constant, while insecticide exports decreased by 8 percent and fungicides decreased by some 20 percent (tables 4b, 4c, & 4d, respectively).

During this period, U.S. exports to Europe varied by region, with insecticides being shipped in large quantities to southern Europe for use on orchards, and herbicides being shipped to northern Europe for use on cereal crops. The official export data indicate that

Belgium, France, and the Netherlands are the primary EU markets. However, Rotterdam and Antwerp are major chemical ports in which pesticide products are likely unloaded for shipment throughout the EU. Japan with its large rice crop was a major export market for insecticides and fungicides. However, exports to Japan varied cyclically with the rice crop.

Although the markets in the major industrialized countries have been cyclical, selected countries have exhibited significant growth. In the last 5 years, Australia, Colombia, Mexico, and Hong Kong have accounted for only approximately 16 percent of total U.S. exports. Nevertheless, they have exhibited the fastest growth and are expected to remain significant U.S. export markets in the future.[42]

U.S. TRADE BALANCE

The future of the U.S. trade balance will depend on a number of factors. As world growth of the pesticides industry slows, U.S. exports will also likely slow, particularly if U.S. firms set up production facilities in local economies. U.S. exports to Europe will likely decline should the EU impose stricter environmental rules or reduce its crop price supports as instituted by the EU's CAP.[43] On the positive side, despite the presence of European and Japanese firms, the U.S. trade balances with South America and the Far East have a potential for growth, particularly as these countries continue to industrialize and acquire more sophisticated agriculture methods. Also on the positive side, the United States appears to be a leader in developing new products. This expertise has not gone unnoticed by the European pesticide industry.

The American companies now command the high position as is shown by their recent successes in developing and introducing most of the major innovations over the last ten years. They also have the capabilities to invest heavily in the agricultural biotechnology area, arguably the seat of the next breakthroughs in the fight against major crop pests.[44]

As the developing countries increase their pesticide consumption, the United States will be in a good position to export the latest technology. Also as mentioned above (Structure of the U.S. Industry), the U.S. industry has been among the most profitable segments of the world pesticide industry in recent years.

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[42] *Chemical Marketing Reporter,* "Farm Chemicals, A CMR Special Report," May 20, 1991 p. 20.

[43] Data in this table represent countries with the largest aggregate trade (e.g., exports plus imports); therefore, the order in which the countries appear in this table doesn't necessarily correspond with the country order in tables 5 or 6.

[44] Data for 1988 based on the TSUS are suppressed.

[45] As discussed above, in the section on European Regulation, changes in the CAP could have extensive effects on the use of pesticides.

[46] International Group of National Associations of Manufacturers of Agrochemical Products (GIFAP), *Supplementary Memorandum On The Need For Patent Term Restoration For Agrochemicals,* July 1990, p. 4.

Table 7
Pesticide products and formulations: U.S. exports of domestic merchandise, imports for consumption, and merchandise trade balance, by selected countries and country groups, 1988-92[1]

(Million dollars)

Item	1988	1989	1990	1991	1992
U.S. exports of domestic merchandise:					
Canada	(2)	211	312	299	305
Japan	(2)	122	115	154	155
United Kingdom	(2)	56	43	48	64
Switzerland	(2)	31	29	19	25
Germany	(2)	23	53	48	29
Brazil	(2)	46	43	63	60
France	(2)	67	93	56	66
Netherlands	(2)	60	133	112	77
Belgium	(2)	154	166	114	92
Mexico	(2)	46	53	57	61
All other	(2)	621	493	481	541
Total	523	1,439	1,533	1,452	1,474
EC-12	(2)	403	527	413	354
OPEC	(2)	29	40	45	46
ASEAN	(2)	77	73	68	78
CBERA	(2)	57	68	70	85
Eastern Europe	(2)	4	6	2	1
U.S. imports for consumption:					
Canada	(2)	12	18	22	31
Japan	(2)	44	55	59	85
United Kingdom	(2)	93	89	98	140
Switzerland	(2)	120	124	117	147
Germany	(2)	126	107	114	115
Brazil	(2)	57	39	57	56
France	(2)	29	37	38	40
Netherlands	(2)	17	23	17	24
Belgium	(2)	6	4	3	8
Mexico	(2)	9	18	16	11
All other	(2)	117	112	104	125
Total	541	630	626	645	782
EC-12	(2)	300	287	295	356
OPEC	(2)	2	2	1	3
ASEAN	(2)	2	5	6	8
CBERA	(2)	8	7	4	9
Eastern Europe	(2)	0	1	0	0
U.S. merchandise trade balance:					
Canada	(2)	199	294	277	274
Japan	(2)	78	60	95	70
United Kingdom	(2)	-37	-46	-50	-76
Switzerland	(2)	-89	-95	-98	-122
Germany	(2)	-103	-54	-66	-86
Brazil	(2)	-11	4	6	4
France	(2)	38	56	18	26
Netherlands	(2)	43	110	95	53
Belgium	(2)	148	162	111	84
Mexico	(2)	37	35	41	50
All other	(2)	504	381	377	416
Total	-18	809	907	807	692
EC-12	(2)	103	240	118	-2
OPEC	(2)	27	38	44	43
ASEAN	(2)	75	68	62	70
CBERA	(2)	49	61	66	76
Eastern Europe	(2)	4	5	2	1

[1] Import values are based on customs value; export values are based on f.a.s. value, U.S. port of export. U.S. trade with East Germany is included in "Germany" but not "Eastern Europe"

[2] Country detail provided only for years in which there are actual import data under the HTS—suppressed for years in which data were derived from the TSUS using a concordance.

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

APPENDIX A
EXPLANATION OF TARIFF AND TRADE AGREEMENT TERMS

EXPLANATION OF TARIFF AND TRADE AGREEMENT TERMS

The ***Harmonized Tariff Schedule of the United States*** (HTS) replaced the *Tariff Schedules of the United States* (TSUS) effective January 1, 1989. Chapters 1 through 97 are based upon the internationally adopted Harmonized Commodity Description and Coding System through the 6-digit level of product description, with additional U.S. product subdivisions at the 8-digit level. Chapters 98 and 99 contain special U.S. classification provisions and temporary rate provisions, respectively.

Rates of duty in the general subcolumn of HTS column 1 are most-favored-nation (MFN) rates; for the most part, they represent the final concession rate from the Tokyo Round of Multilateral Trade Negotiations. Column 1-general duty rates are applicable to imported goods from all nonembargoed countries except those enumerated in general note 3(b) to the HTS plus Serbia and Montenegro, whose products are dutied at the rates set forth in ***column 2***. Goods from Albania, Armenia, Belarus, Bulgaria, the People's Republic of China, the Czech Republic, Estonia, Georgia, Hungary, Kazakhstan, Kyrgyzstan, Latvia, Lithuania, Moldova, Mongolia, Poland, Romania, Russia, Slovakia, Turkmenistan, Ukraine, and Uzbekistan are currently eligible for MFN treatment, as are the other republics of the former Socialist Federal Republic of Yugoslavia. Among articles dutiable at column 1-general rates, particular products of enumerated countries may be eligible for reduced rates of duty or for duty-free entry under one or more preferential tariff programs. Such tariff treatment is set forth in the ***special*** subcolumn of HTS column 1. Where eligibility for special tariff treatment is not claimed or established, goods are dutiable at column 1-general rates.

The ***Generalized System of Preferences*** (GSP) affords nonreciprocal tariff preferences to developing countries to aid their economic development and to diversify and expand their production and exports. The U.S. GSP, enacted in title V of the Trade Act of 1974 and renewed in the Trade and Tariff Act of 1984, applies to merchandise imported on or after January 1, 1976 and before September 30, 1994. Indicated by the symbol "A" or "A*" in the special subcolumn of column 1, the GSP provides duty-free entry to eligible articles the product of and imported directly from designated beneficiary developing countries, as set forth in general note 4 to the HTS.

The ***Caribbean Basin Economic Recovery Act*** (CBERA) affords nonreciprocal tariff preferences to developing countries in the Caribbean Basin area to aid their economic development and to diversify and expand their production and exports. The CBERA, enacted in title II of Public Law 98-67, implemented by Presidential Proclamation 5133 of November 30, 1983, and amended by the Customs and Trade Act of 1990, applies to merchandise entered, or withdrawn from warehouse for consumption, on or after January 1, 1984; this tariff preference program has no expiration date. Indicated by the symbol "E" or "E*" in the special subcolumn of column 1, the CBERA provides duty-free entry to eligible articles, and reduced-duty treatment to certain other articles, which are the product of and imported directly from designated countries, as set forth in general note 7 to the HTS.

Preferential rates of duty in the special subcolumn of column 1 followed by the symbol "IL" are applicable to products of Israel under the ***United States-Israel Free Trade Area Implementation*** Act of 1985 (IFTA), as provided in general note 8 to the HTS. Where no rate of duty is provided for products of Israel in the special subcolumn for a particular provision, the rate of duty in the general subcolumn of column 1 applies.

Preferential nonreciprocal duty-free or reduced-duty treatment in the special subcolumn of column 1 followed by the symbol "J" or "J*" in parentheses is afforded to eligible articles the product of designated beneficiary countries under the ***Andean Trade Preference Act*** (ATPA), enacted in title II of Public Law 102-182 and implemented by Presidential Proclamation 6455 of July 2, 1992 (effective July 22, 1992), as set forth in general note 11 to the HTS.

Preferential rates of duty in the special subcolumn of column 1 followed by the symbol "CA" are applicable to eligible goods of Canada, and those followed by the symbol "MX" are applicable to eligible goods of Mexico, under the ***North American Free Trade Agreement***, as provided in general note 12 to the HTS, effective January 1, 1994.

Other special tariff treatment applies to particular ***products of insular possessions*** (general note 3(a)(iv)), goods covered by the ***Automotive Products Trade Act*** (APTA) (general note 5) and the ***Agreement on Trade in Civil Aircraft*** (ATCA) (general note 6), and ***articles imported from freely associated states*** (general note 10).

The ***General Agreement on Tariffs and Trade*** (GATT) (61 Stat. (pt. 5) A58; 8 UST (pt. 2) 1786) is a multilateral agreement setting forth basic principles governing international trade among its signatories. The GATT's main obligations relate to most-favored-nation treatment, the maintenance of scheduled concession rates of duty, and national (nondiscriminatory) treatment for imported products; the GATT also provides the legal framework for customs valuation standards, "escape clause" (emergency) actions, antidumping and countervailing duties, and other measures. Results of GATT-sponsored multilateral tariff negotiations are set forth by way of separate schedules of concessions for each participating contracting party, with the U.S. schedule designated as Schedule XX.

Officially known as "The Arrangement Regarding International Trade in Textiles," the ***Multifiber Arrangement*** (MFA) provides a framework for the negotiation of bilateral agreements between importing and producing countries, or for unilateral action by importing countries in the absence of an agreement. These bilateral agreements establish quantitative limits on imports of textiles and apparel, of cotton and other vegetable fibers, wool, man-made fibers and silk blends, in order to prevent market disruption in the importing countries—restrictions that would otherwise be a departure from GATT provisions. The United States has bilateral agreements with many supplying countries, including the four largest suppliers: China, Hong Kong, the Republic of Korea, and Taiwan.