NITROGEN

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Nitrogen (N) is an essential element of life and a part of all plant and animal proteins. As a part of the deoxyribonucleic acid and ribonucleic acid molecules, nitrogen is an essential constituent of each individual's genetic blueprint. As an essential element in the chlorophyll molecule, nitrogen is vital to a plant's ability to photosynthesize. Some crop plants, such as alfalfa, soybeans, garden peas, and peanuts, can convert atmospheric nitrogen into a usable form in a process called fixation. Most nitrogen available for crop production, however, comes from decomposing animal and plant waste or from commercially produced fertilizers.

All commercial fertilizers contain their nitrogen in the ammonium and/or nitrate form or in a form that is quickly converted to these forms once the fertilizer is applied to the soil. Commercial production of anhydrous ammonia is based on reacting nitrogen with hydrogen under high temperatures and pressures. The source of nitrogen is air, which is almost 80% nitrogen. Hydrogen is derived from a variety of raw materials, including water, and crude oil, coal, or natural gas hydrocarbons. Other nitrogen fertilizers are produced from ammonia feedstocks through a variety of chemical processes. Small quantities of nitrates are produced from mineral resources principally in Bolivia and Chile.

In 2001, U.S. ammonia production was 9.73 million metric tons (Mt) of contained nitrogen, a 22% drop from that in 2000. A significant portion of this decline occurred in the beginning of the year when about 40% of the ammonia production capacity was closed owing to high natural gas prices. Although the United States produced most of its ammonia requirements, the country had an import reliance of 30%, with most of the imports in 2001 coming from Canada, Trinidad and Tobago, and Ukraine. Although imports increased by about 700,000 metric tons (t) of contained nitrogen to make up for some of the shortfall in U.S. production, apparent consumption decreased by 12%. Weak ammonia demand owing to decreased corn plantings, wet spring weather in the Midwestern United States, and a decline in demand for offshore diammonium phosphate (DAP) led to the decline in ammonia consumption in 2001. About 88% of the ammonia consumed in the United States was used in fertilizer applications.

Global ammonia production in 2001 decreased by about 2% from that of 2000 to about 106 Mt of contained nitrogen. A drop in production of about 3.5 Mt in North America was responsible for most of the decline. China, India, and the United States continued to be the principal producers, together accounting for about 45% of the total. In 2001, world urea production decreased slightly to 49.4 Mt of contained nitrogen. Urea exports also fell, decreasing by about 4% to 11.5 Mt of contained nitrogen. China and India, the two largest producing countries, accounted for 48% of world production; production in China increased by about 3%, and production in India decreased by 3% compared with those of 2000. The United States and Canada produced about 9% of the total.

Legislation and Government Programs

On December 10, China became a member of the World Trade Organization (WTO). This accession effectively ends China's ban on urea imports that began in 1997. Under the agreements established in earlier negotiations, tariff rate quotas (TRQs) were established for imports of agricultural products, including urea and DAP, with a fixed tariff rate of 4%. In 2002, the TRQ for urea was 2.70 Mt, with 90% of the quota going to state trading enterprises (STEs) and 10% to private importers. By 2010, this TRQ increases to 3.30 Mt, with 51% to STEs and 49% to private importers. For DAP, the 2002 quota is 5.40 Mt, increasing to 7.98 Mt in 2010, with the same percentages allocated to STEs and private companies (Fertilizer Week, 2001c).

The U.S. Trade Representative (USTR), however, issued complaints to the Chinese Government about its introduction of a two-tiered system to import fertilizers and other products. According to the USTR, this is contrary to what China agreed to in WTO negotiations. Under the two-tiered system, the Chinese authorities have unilaterally divided the quota into two categories that differentiate between processing and nonprocessing trades. This could create an oversubscription of quotas under one category and an undersubscription by the other, which could prevent the total import quota to be reached (Fertilizer Markets, 2001f). China did not issue TRQs for 2002 until April and indicated that the country's need would be met first with locally produced material and supplemented with imports if necessary (Fertilizer Markets, 2002).

After completing an investigation into dumping of ammonium nitrate from Ukraine that was begun in 2000, the U.S. International Trade Commission (ITC) issued its final determination in August 2001. The ITC determined that imports of ammonium nitrate from Ukraine were sold in the United States at less than fair value, and that critical circumstances did not exist with regard to these imports. As a result of the negative determination regarding critical circumstances, the duties will not be retroactive and will only apply to ammonium nitrate that has been imported since March 5, 2001. The antidumping duty of 156.29% ad valorem that was finalized by the International Trade Administration in July will be applied (U.S. Department of Commerce, International Trade Administration, 2001; U.S. International Trade Commission, 2001).

Production

Industry statistics for anhydrous ammonia and derivative products were developed by the U.S. Census Bureau. A summary of the production of principal inorganic fertilizers by quarter was reported in the series MQ325B, and industrial gases (including nitrogen) were reported in the quarterly report MQ325C. Final data for inorganic fertilizers were subsequently published in the companion annual report MA325B, and data for industrial gases were published in the annual report MA325C.

In 2001, production of anhydrous ammonia (82.2% nitrogen) decreased by 22% to 9.73 Mt of contained nitrogen compared with a revised figure of 12.5 Mt in 2000 (table 1). Of the total production, 88% was for use as a fertilizer; the remaining 12% was used in other chemical and industrial sectors (table 2).

The United States remained the world's second largest producer and consumer of elemental and fixed types of nitrogen following China. In declining order, urea, ammonium phosphates (DAP, monoammonium phosphate, and other ammonium phosphates), ammonium nitrate, nitric acid, and ammonium sulfate were the major downstream products produced from ammonia in the United States. Their combined production was 9.44 Mt of contained nitrogen, with urea accounting for about 31% of the production (table 3). Of the urea produced in the United States in 2001, 32% was used for urea-ammonium nitrate solutions (UAN) production, 41% was consumed in granular form, 23% was consumed in prill form, and 4% was consumed in feedstock for other uses, such as melamine production.

Ammonia producers in the United States operated only at about 56% of design capacity; this percentage includes capacities at plants that operated during any part of 2001. Of the plants that operated in 2001, more than 55% of total U.S. ammonia production capacity was concentrated in the States of Louisiana (33%), Oklahoma (13%), and Texas (9%), owing to large indigenous reserves of feedstock natural gas. Farmland Industries Inc., Terra Industries Inc., PCS Nitrogen Inc., CF Industries Inc., Agrium Inc., and Mississippi Chemical Corp., in declining order, accounted for 74% of total U.S. ammonia capacity (table 4).

Natural gas prices, which had begun to rise precipitously at the end of 2000, continued to increase into early January 2001, prompting additional cutbacks in U.S. ammonia production. Mississippi Chemical shut down all its nitrogen-producing capacity at Donaldsonville, LA, at the beginning of January, which included 946,000 metric tons per year (t/yr) of ammonia production capacity (Fertilizer Markets, 2001e). Terra Industries reported that most of its North American facilities also were idled in January because it did not commit to natural gas purchases for the month. The company had idled its Beaumont, TX, facility in 2000 and idled an additional 1.5 million metric tons per year (Mt/yr) of ammonia production capacity with the closing of the remaining plants in Blytheville, AR, Port Neal, IA, and Woodward, OK, and one-half of its capacity at Verdigris, OK (Green Markets, 2002). In addition, Cytec Industries Inc. closed its Avondale ammonia plant in Fortier, LA, in January and was adding a natural gas surcharge to its melamine prices. This plant closed permanently in July. These closures along with the ammonia capacity that was closed at the end of 2000 totaled 6.24 Mt/yr of idled capacity at the beginning of 2001. Much of the urea and UAN capacity that uses ammonia produced by these plants as feed material also was idled. As natural gas prices began to decline in the first quarter of 2001, most of the idled capacity came back on-line; most of the capacity was reopened by the end of February to prepare for the spring planting season.

Weak domestic ammonia demand, owing to a decrease in corn plantings, wet spring weather in the Midwestern United States, a decline in offshore DAP demand, and an increase in U.S. imports, led to U.S. ammonia capacity closures beginning in April. By the end of June, 3.9 Mt/yr of ammonia production capacity was idled, including 0.9 Mt/yr of permanently closed capacity. In addition to the announced closings, many companies extended their normal maintenance shutdowns, further reducing operating ammonia capacity. By October, as natural gas prices fell to about $2.00 per million British thermal units, much of the ammonia production capacity that had been closed was reopened.

In May, Farmland and SynFuel Technologies LLC announced that they had signed a letter of intent for SynFuel to develop a coal gasification plant adjacent to Farmland's Enid, OK, ammonia facility. Under terms of the agreement, which is for at least 10 years, Farmland will purchase hydrogen, nitrogen, steam, and other utilities from the coal gasification plant for use in the ammonia facility. Farmland estimated that the cost to purchase raw materials from the gasification plant would be about 40% of the cost of natural gas. Construction at the $800 million gasification plant was expected to begin in August 2002, with completion scheduled for June 2004. The plant will use about 9,100 metric tons per day (t/d) of coal from Wyoming's Powder River basin, with one-half used for ammonia production and one-half used for electricity production. Farmland already operates one ammonia plant based on petroleum coke feed in Coffeyville, KS (Green Markets, 2001f).

After filing for chapter 11 bankruptcy in May 2000, LaRoche Industries Inc. filed a plan for reorganization in May 2001. Under this plan, which was approved by the U.S. Bankruptcy Court, LaRoche will exist as an industrial ammonia supplier. LaRoche also completed the sale of its share of the Avondale ammonia plant to the co-owner Cytec Industries (Green Markets, 2001g). Citing the difference between the economics of producing ammonia and the cost of offshore ammonia, Cytec Industries announced that it was closing the 399,000-t/yr Avondale ammonia plant in July. The company used about one-half of the plant's production for its specialty chemical manufacturing plant, and closing the operation would eliminate the need to sell the remaining production on the open market (Green Markets, 2001c).

In May, E.I. du Pont de Nemours & Co. (DuPont) announced that it was closing its 496,000-t/yr Beaumont, TX, ammonia plant by the end of June owing to escalating natural gas prices. Ammonia produced at the Texas plant provided feedstock for DuPont's acrylonitrile and aniline production at the same location. Closure of the plant will affect 66 employees (Green Markets, 2001d).

In March, the $24 billion merger between Coastal Corp. and El Paso Corp. was completed. The ammonia plants owned by

Coastal were incorporated into the subsidiary El Paso Merchant Energy Group.

Producers, dealers, and distributors of ammonia were urged to increase their security measures to stop the theft of ammonia for use in production of methamphetamine. Ammonia is often stolen from nurse tanks by bleeding hoses or by siphoning it from valves on traincars. The quantity needed is small, and its theft often goes unnoticed. A daring incident of ammonia theft took place when a hole was drilled into Koch Pipeline Co. L.P.'s ammonia pipeline near Pollack, LA, in August. The Fertilizer Institute issued a leaflet targeted toward retailers and farmers covering steps that they can do to protect themselves from theft, including storing tanks in high-traffic, well-lit areas; inspecting tanks frequently, particularly following weekends; and removing hoses when the tanks are parked (The Fertilizer Institute, 2002§[1]).

Environment

The ammonium and nitrate forms of nitrogen are highly soluble in water and are readily available for crop plant uptake. Ammonium is held by soil particles and, therefore, is not subject to movement down through the soil during periods of rainfall or irrigation. Nitrates, however, do move downward with soil water. This leaching process can lead to nitrate accumulation in ground water. As soils are warmed during the growing season, the ammonium form of nitrogen is subject to conversion to nitrate in a process called nitrification. Most of the ammonium not used by the crop is eventually converted to nitrate. Nitrogen stabilizers and nitrification inhibitors can slow the conversion of soil ammonium to nitrate. Best management practices to increase nitrogen use efficiency and to reduce nitrate leaching include application of fertilizer close to the time of actual crop use, multiple applications, terracing, grass waterways, and strip cropping.

Hypoxia in the Gulf of Mexico recently has become a controversial environmental concern for the fertilizer industry and an issue that spawned significant research efforts to determine its cause. "Hypoxia in the Gulf of Mexico" refers to the phenomenon that happens in an area along the Louisiana-Texas coast where water near the bottom of the Gulf contains less than 2 parts per million of dissolved oxygen. Hypoxia can cause stress or death in bottom-dwelling organisms that cannot move out of the hypoxic zone. Some studies postulated that nitrate runoff from fertilizers is the principal cause of hypoxia, while others cited other causes for the hypoxic zone.

On January 18, an action plan for controlling hypoxia in the Gulf of Mexico was prepared by members of the Mississippi River/Gulf of Mexico Watershed Nutrient Task Force and submitted as a report to Congress. A major goal of the action plan is to reduce the size of the hypoxic zone to less than 5,000 square kilometers, which is a reduction of the hypoxic zone by about one-half of the average, by 2015. States, tribes, and the relevant Federal agencies with jurisdiction in the Mississippi and Atchafalaya river basins and the Gulf agreed to the actions in the plan, including preparing watershed strategies to reduce the amount of nutrients, particularly nitrogen, entering their waters. These groups would have flexibility to develop the most effective and practical strategies to reduce discharges of excess nutrients to their waters. The strategies were expected to rely heavily on voluntary and incentive-based approaches for dealing with agricultural and urban runoff, restoring wetlands, and creating vegetative or forested buffers along rivers and streams within priority watersheds. The best current [2001] scientific understanding of the hypoxic zone indicated that these strategies should aim at achieving a 30% reduction in nitrogen discharges to the Gulf by 2015 (U.S. Environmental Protection Agency, 2001§).

A report prepared by the International Fertilizer Industry Association and the Food and Agriculture Organization of the United Nations estimated global emissions of nitrogen oxides (N_2O and NO) and ammonia volatilization losses from fertilizer and manure application to fields used for crop production. Quantification of nitrogen emissions is important to assess fertilizer efficiency and nitrogen's impact on atmospheric pollution and ecosystem acidification and eutrophication. Modeling techniques generated global estimates of 3.5 Mt/yr of N_2O-N emissions and 2.0 Mt/yr of NO-N emissions from crop and grassland. An ammonia loss of 14% was estimated for mineral fertilizer use (higher in developing countries), and that from animal manure was estimated to be 22% (International Fertilizer Industry Association and the Food and Agriculture Organization of the United Nations, 2001§).

Consumption

In 2001, apparent consumption of ammonia decreased by 12% to 13.8 Mt of contained nitrogen. Apparent consumption is calculated as the production plus imports minus exports, adjusted to reflect any changes in stocks.

Consumption of nitrogen fertilizers in the United States for the 2001 crop year (ending June 30, 2001) is listed in table 5. Consumption of 11.5 Mt of contained nitrogen was about 8% less than that in the revised figure for 2000. Anhydrous ammonia was the principal fertilizer product, representing 32% of fertilizer consumption. Of the single-nutrient fertilizers, only consumption of urea and ammonium sulfate increased from that in the 2000 crop year.

Other uses of ammonia are in the production of amines, cyanides, and methyl methacrylate polymers (plexiglass); in liquid household and industrial cleaners; in industrial stack-gas scrubbing; in pulp and paper products; in industrial refrigeration; in metallurgy; and as a propellant in vehicular air bags.

Urea and UAN solutions constituted 41% of fertilizer consumption during the 2001 crop year. Urea is typically 45.9% nitrogen, and UAN solutions are typically 29.8% to 29.9% nitrogen. In the industrial sector, urea is used extensively as a protein supplement in ruminant animal feeds, in the production of urea-formaldehyde adhesives, and in the synthesis of plastics and resins.

Ammonium nitrate was used primarily in solid and liquid fertilizers, in industrial explosives, and as blasting agents. After World War II, ammonium nitrate became the leading solid nitrogen fertilizer in the United States and worldwide, and

[1]References that include a section twist (§) are found in the Internet References Cited section.

remained so until about 1975 when its use was surpassed by synthetic urea. Ammonium nitrate containing 33.9% nitrogen constituted 4% of 2001 nitrogen fertilizer consumption.

Ammonium sulfate was used mostly as a fertilizer material, valued for its nitrogen content (21.2% nitrogen) and its readily available sulfur content (24.3% sulfur). It is commonly produced as a byproduct of caprolactam production, an intermediate in nylon manufacture. Since the introduction of ammonium nitrate and urea as fertilizer materials, the relative importance of ammonium sulfate worldwide has steadily decreased. In the 2001 crop year, fertilizer consumption of ammonium sulfate, based on nitrogen content, was 2% of the total nitrogen-based fertilizer market. Nonfertilizer uses of ammonium sulfate include food processing, fire control, tanning, and cattle feed.

Nitric acid production is listed in table 3. Nitric acid is used in salt formation reactions to produce metal nitrates and in metal degreasing, treating, and pickling for the graphic and galvanic industries. Nitration reactions with benzene, phenol, and toluene produce dyestuffs, pharmaceutical products, trinitrotoluene explosives, and disinfectants. Esterification reactions with glycol, glycerol, and cellulose produce nitroglycerine explosives (dynamite), celluloid, and nitrocellulose lacquers. Oxidation reactions with toluene, p-xylene, and cyclohexanone produce polyurethanes and polyester fibers (nylon).

Elemental nitrogen is used extensively by the electronics, metals, food, and aerospace industries owing to its inert and cryogenic properties. Nitrogen can be used to prevent fires and explosions, as a purging agent for cleaning and processing equipment, and as a controlling atmosphere for annealing and heat treating and other metal preparation processes where oxygenation is a concern.

Stocks

Stocks of ammonia at yearend 2001 were 0.92 Mt, a decrease of 18% from those at the end of 2000, according to data published by The Fertilizer Institute (table 6). The U.S. Census Bureau reported ending stocks of ammonia to be 312,000 t, which was a significant difference from The Fertilizer Institute data. The U.S. Census Bureau ending stocks for 2000 were 370,000 t; the difference between 2001 and 2000 yearend stocks reported by the U.S. Census Bureau was 16%. Although the U.S. Geological Survey (USGS) traditionally has used U.S. Census Bureau data in calculating apparent consumption, the calculation was computed using The Fertilizer Institute data to minimize irregularities caused by continually switching data series—U.S. Census Bureau inventory data are occasionally withheld.

Transportation

Ammonia was transported by refrigerated barge, rail, pipeline, and truck. Three companies serve 11 States with 4,900 kilometers (km) of pipelines, with 4,800 km of river barge transport, and with rail and truck used primarily for interstate or local delivery.

Koch Industries Inc., through its subsidiary Koch Pipeline Co., operated the Gulf Central ammonia pipeline from the Gulf of Mexico (Louisiana) to the Midwest as far north as Iowa, spanning 3,070 km, and to the east to Huntington, OH. The capacity of this pipeline was about 2 Mt/yr, with a storage capacity of more than 1 Mt. CF Industries and Cargill Fertilizer Inc. jointly operated the 135-km-long Tampa Bay Pipeline (TBP) system. The TBP moved nitrogen compounds and ammonium phosphate for fertilizer producers in Hillsborough and Polk Counties, FL. The pipelines of Williams Companies, Inc., and its subsidiary Mid-America Pipeline Co. extend from Borger in northern Texas to Mankato in southern Minnesota, covering 1,700 km. The pipelines have a capacity of more than 1 Mt/yr and about 500,000 t of ammonia storage capacity.

The U.S. Court of Appeals for the District of Columbia upheld a May 9, 2000, determination by the Surface Transportation Board (STB) that disallowed certain rate increases implemented in 1996 by Koch Pipeline for the transportation of ammonia. Koch Pipeline was ordered to reduce its rates to the preincrease levels and to pay reparations to CF Industries and Farmland Industries for past transportation to 19 pipeline destinations in the Midwest. In its initial ruling, the STB had determined that Koch already was earning adequate revenues at the preincrease rate level and that it had already recovered nearly all of its investment in the ammonia pipeline (Green Markets, 2001b).

Capacities for trucks and railcars are usually 20 t and 100 t, respectively. Depending on the product loaded and the volume of the container, barges can accommodate from 400 t to 2,000 t.

Ammonium nitrate is transported by rail, road, and water, but its transportation on U.S. navigable waterways is restricted. Urea is shipped either in bulk or as bagged material.

Prices

Owing to the high price of natural gas, the prices of most nitrogen compounds climbed during the first 2 months of 2001, then fell as natural gas prices began to fall. (The relation between natural gas and ammonia prices is shown in figure 1.) Gulf Coast ammonia reached a peak average price of $310 per short ton ($342 per metric ton) by the end of January, then began to decline quickly until the price reached $200 per short ton ($220 per metric ton) by mid-March (figure 2). Prices continued to drop more slowly until the average price was $125 per short ton ($138 per metric ton) at yearend. Prices for urea and ammonium nitrate followed similar patterns. The Gulf Coast granular urea price increased to a high of $208 per short ton ($229 per metric ton) by the end of January, then fell until it bottomed out in mid-June at $96.50 per short ton ($106 per metric ton) (figure 3). This price leveled off between $104 and $113 per short ton ($115 and $125 per metric ton) throughout the rest of 2001, ending the year at $106 per short ton ($117 per metric ton). The ammonium nitrate price rose to a high of $208 per short ton ($229 per metric ton) by mid-February, then declined throughout the year to $125 per short ton ($138 per metric ton) by yearend (figure 4).

Ammonium sulfate, however, did not follow the same trends as other nitrogen compounds. This is because much of the ammonium sulfate in the United States is produced as a byproduct of coke ovens, where sulfuric acid is used to remove ammonia generated from the coal, and does not respond as directly to the changes in natural gas pricing. Throughout the first half of 2001, the average ammonium sulfate price was relatively steady, ranging between $140 and $142 per short ton ($154 and $157 per metric ton). By the end of July, this price fell to $127 per short ton ($140 per metric ton), where it remained through the rest of the year (figure 5).

Foreign Trade

Ammonia exports declined slightly from those in 2000 (table 8). The Republic of Korea, which remained the principal destination, accounted for 69% of total U.S. exports of ammonia. Most of the material shipped to the Republic of Korea was produced at the Agrium plant in Alaska. Mexico, with 12% of the total, and Taiwan, with 11%, were the next largest destinations.

To replace some of the shortfall in domestic ammonia production, imports increased by 17% from those in 2000. The U.S. Census Bureau began reporting quantities of ammonia shipped from Russia and Ukraine in 2001 instead of only the value of the imports, so the data on imports from these countries are likely to be more accurate than the information that was estimated from the Journal of Commerce, which did not distinguish between ammonia shipped from Russia and Ukraine. Trinidad and Tobago (52%) continued to be the largest import source. Ukraine (15%), Canada (14%), and Russia (6%) were the remaining significant import sources.

Tables 10 and 11 list trade of other nitrogen materials and include information on principal source or destination countries. Most of the imports of nitrogen materials increased in 2001. In addition to increased imports of ammonia, urea and UAN solution imports also increased by 23% and 53%, respectively. These imports replace some of the domestic material that was lost when U.S. production capacity was closed for an extended period.

World Review

Anhydrous ammonia and other nitrogen materials were produced in more than 80 countries. Global ammonia production in 2001 decreased by about 2% from that of 2000 (table 12); lower production in North America was responsible for most of the total decline. In 2001, total ammonia production was 106 Mt of contained nitrogen, according to data reported to the USGS. China, with 26% of this total, was the largest world producer of ammonia. Asia contributed 45% of total world ammonia production, and countries in the former Soviet Union represented 14% of the global total. North America produced 13% of the total; Western Europe, 10%; the Middle East, 7%; Latin America, 5%; and Africa, Eastern Europe, and Oceania contributed the remaining 6%.

In 2001, world ammonia exports of 12.6 Mt of contained nitrogen were slightly lower than those in 2000. Trinidad and Tobago (22%), Russia (18%), Ukraine (11%), Indonesia (5%), and the United States (5%) accounted for 61% of the world total. The United States imported 35% of global ammonia trade, followed by Western Europe (25%) and Asia (20%) (International Fertilizer Industry Association, 2002a).

In 2001, world urea production decreased slightly to 48.7 Mt of contained nitrogen. Urea exports also fell, decreasing by about 4% to 11.5 Mt of contained nitrogen. China and India, the two largest producing countries, accounted for 48% of world production; production in China increased by about 3%, and production in India decreased by 3% compared with those of 2000. The United States and Canada produced about 9% of the total. Countries from the former Soviet Union exported the largest quantity of urea with 28% of the total. The Middle East accounted for 23% of total exports, Asia for 15%, North America for 9%, Western Europe and Africa for 7% each, and Eastern Europe and Latin America for 6% each. Asia accounted for 26% of global urea imports, North America for 25%, Western Europe for 15%, and Latin America for 14% (International Fertilizer Industry Association, 2002b). The above percentages for trade in ammonia and urea reflect material that is shipped intraregion as well as material that is shipped among regions; for example, material shipped from Canada to the United States is included in the North American trade shipments.

European Union.—After an investigation begun in October 2000 at the request of the European Fertilizer Manufacturers Association, the European Commission (EC) established provisional antidumping duties on imports of urea from Belarus, Bulgaria, Croatia, Estonia, Libya, Lithuania, Romania, and Ukraine. Two other countries that were investigated, Egypt and Poland, were determined to have a declining share of the European Union (EU) market, and the average price of material from these countries was much higher than those that were penalized. Antidumping duties were established as follows: Belarus, 5.46 euros (€) per metric ton; Bulgaria, € 18.80 per ton; Croatia, € 12.18 per ton; Estonia, € 17.67 per ton; Libya, € 8.87 per ton; Lithuania, € 6.89 per ton; Romania, € 4.12 to € 8.42 per ton, depending on the producer; and Ukraine € 6.25 to € 13.90 per ton, depending on the producer (Fertilizer Week, 2001d).

In January, the EC extended its antidumping duties on imports of ammonium nitrate from Poland and Ukraine for 5 years; provisional 6-month duties were established in July 2000. For Poland, the duty ranged from € 20.65 to € 29.91 per ton, depending on the producer. For Ukraine, the country-wide duty was € 33.25 per ton. An antidumping duty of € 26.3 per ton was already in place on imports of ammonium nitrate from Russia (Green Markets, 2001e).

In May, the EU imposed antidumping duties of € 19 to € 22 per ton, depending on the producer, on imports of UAN from Poland. These duties replaced a minimum import price. At the same time, the EU renewed its existing minimum import price measures on imports of urea from Russia. The duty was set as the difference between the minimum import level of € 115 per ton and the net free-at-EU-frontier price (Fertilizer Week, 2001e).

Argentina.—By mid-January, the 1.1 Mt/yr Profertil S.A. urea plant was running at full capacity and had set a world record of 3,250 t for one day's production from a single-production train. The plant is a joint venture between Agrium and Repsol YPF (Fertilizer Markets, 2001c).

Australia.—India's Oswal Projects Ltd. announced that it would construct a 600,000-t/yr ammonia plant on Australia's

Burrup Peninsula. Ammonia produced at the plant was expected to be exported to India where it would be used in its DAP-nitrogen-phosphorous-potassium fertilizer plant. Owing to rising domestic energy costs, Indian fertilizer producers have begun to establish ammonia plants in overseas locations, where energy costs are less. Construction of the plant, which would operate under the name Burrup Fertilisers Pty. Ltd., was scheduled to begin in the first quarter of 2002, with start-up by early 2004. In July, Oswal signed a memorandum of understanding with Norsk Hydro ASA covering delivery of ammonia from the proposed plant to Oswal Chemical and Fertlisers Ltd.'s DAP plant in Uttar Pradesh. The company also signed a gas supply agreement with the Harriet Joint Venture of Apache Oil Co. Ltd. to supply more than 73 terajoules per day of gas to the ammonia plant. The new plant is expected to use Kellogg Brown & Root's (a unit of Halliburton Co.) latest ammonia process (Fertilizer Week, 2001p).

Belarus.—The country's only nitrogen fertilizer producer GrodnoAzot, which is 100%-owned by the state, was scheduled to be privatized. According to Belarus' President, the Government would maintain a controlling interest in the plant, but several oil and gas suppliers in Russia and Ukraine have expressed an interest in owning a portion of the plant. The GrodnoAzot plant consists of three ammonia and three urea lines and a nitric acid plant. Two of the three urea lines produced agricultural material for export, and the other was for industrial urea only. The nitric acid plant supplied material for UAN production. An investor would be required to revamp the existing ammonia lines and institute energy-saving measures to reduce gas supply costs. No timetable was set for privatization (Fertilizer Week, 2001g).

Brazil.—In October, the Brazilian Government began an investigation into dumping of ammonium nitrate from Estonia, Russia, and Ukraine. The investigation was requested by Ultrafertil S.A., the country's sole ammonium nitrate producer. In December, although the investigation had not been completed, the authorities established a minimum import price of $109 per metric ton for ammonium nitrate. This is equivalent to the price that Ultrafertil charged its large-volume customers (Fertilizer Week, 2001a).

Bulgaria.—Chimco AD planned to invest up to $170 million over 6 years to modernize its urea production facilities and to increase power and steam production. Chimco was a state-owned operation until 1999, when Bulgaria completed the sale of its 75% ownership of the plant (Fertilizer Week, 2001b).

Canada.—The sharp increase in natural gas prices that resulted in closures at many U.S. ammonia facilities also had the same effect on several plants in Canada. Much of Agrium's nitrogen production capacity in Fort Saskatchewan and Redland, Alberta, was closed at the beginning of the year. Like the U.S. plants, this capacity restarted in mid-February as natural gas prices declined. Agrium again closed its Fort Saskatchewan ammonia and urea plants at the beginning of June owing to weather-related decreases in North American consumption. Agrium also closed Redwater I, the smaller of its two ammonia plants in Redwater, effective June 1, 2001. According to the company, this plant had been a swing producer and would remain down until market conditions improved. The ammonia plant at Fort Saskatchewan came back on-stream in the third quarter, but the other plants remained shut throughout the remainder of 2001 (Agrium Inc., 2001§).

Chile.—Potash Corp. of Saskatchewan (PCS) purchased 18% of Sociedad Quimica y Minera de Chile S.A. (SQM) in October for $129 million. SQM operates a 160,000-t/yr potassium nitrate plant in the Atacama Desert. PCS also operates the 300,000-t/yr PCS Yumbes nitrate plant in the Atacama Desert that it purchased in 2000. Although the companies produced some of the same products, there was no joint marketing arrangement between the two; SQM had a global marketing agreement with Norsk Hydro for its fertilizer products. PCS Yumbes expected to reach full production capacity by the first quarter of 2002. This is about 1 year later than PCS originally forecast when it purchased the operation (Fertilizer Week, 2001r).

China.—At the end of December, Russia's largest ammonia producer TogliattiAzot began construction on a new ammonia import terminal in Zhangjiang. The cost of the terminal was estimated to be about $50 million, and completion was scheduled for the first quarter of 2003. This project was being completed in conjunction with a new Black Sea terminal to be built at Zheleznyy Rog, which would enable increased exports of ammonia from Russia. Exports have been limited owing to restricted access to the Yuzhnyy terminal in Ukraine (Fertilizer Week, 2001z).

Egypt.—Shareholders in Abu Qir Fertilizers Co. approved plans to construct the Abu Qir IV project, which includes units to produce ammonia, ammonium nitrate, calcium ammonium nitrate, and nitric acid. Ammonia capacity is projected to be 1,200 t/d, and the ammonium nitrate-calcium ammonium nitrate capacity would be 2,400 t/d. Four companies were qualified to bid for the construction contract, which was expected to be awarded in the second quarter of 2002. Project completion was scheduled for the second half of 2004 (Fertilizer Markets, 2001a).

Egypt Basic Industries Co. (a joint venture between Kellogg Brown & Root and a local investor) purchased a 260,000-square-meter land parcel in the Suez industrial zone and signed a gas supply agreement with Egyptian General Petroleum Corp. The company planned to construct a 610,000-t/yr ammonia plant at the site, with the ammonia mainly targeted for the export market (Nitrogen & Methanol, 2001e).

France.—An explosion at Grande Paroisse S.A.'s Toulouse ammonium nitrate plant in September destroyed the plant and killed 29 people. TotalFinaElf Group, which owns 80% of Grand Paroisse, began an investigation into the cause of the explosion but had made no determination by yearend. Three theories were being studied the closest to determine the cause—the contamination of ammonium nitrate by other chemicals produced on the site, the explosion of the ammonium nitrate plant leading to the scattering of a mass of metal on the stocks and their detonation, and the explosion of the ammonium nitrate stocks following anomalies in the power supply network (Atofina, 2002§). It is unlikely that the plant will be rebuilt.

Georgia.—In February, the Georgian Government issued a tender to sell a 12-month management contract with an option to purchase 90% of nitrogen producer RustaviAzot. The award criteria would be based on the submission of a package that would provide up to $18 million to revamp the plant and purchase new equipment, including gas turbines. The plant was expected to run at 70% of its capacity after the revamp is completed (Fertilizer Week, 2001f).

Germany.—PCK Raffinerie GmbH closed its 170,000-t/yr ammonia plant in Schwedt/Oder in August. The company also stopped production of the associated calcium ammonium nitrate by the end of September (Fertilizer Week, 2001v).

India.—India's Government introduced a plan that would lead to a deregulation of the urea industry by 2006. In this plan, the retention pricing scheme (RPS) would be eliminated, and oil-product feedstocks would be linked to international market prices. [The RPS ensured project feasibility by allowing an automatic 12% after-tax return on capital investment as soon as new units were commissioned.] To replace the RPS, the Government has proposed a group concession scheme, which would provide a range of concessions based on the feedstock type. The Government also announced that it would increase the domestic urea price ceiling; one recommendation includes increases of 7% per year to the domestic urea price ceiling. Many private sector urea producers were critical of the proposal fearing that it would lead to closure of the country's naphtha- and fuel-oil-fed urea plants, which benefit from the current regulations and represent about 35% of the domestic capacity (Fertilizer Week, 2001h).

Indonesia.—PT Kaltim Parna Industri [a joint venture between Japanese firms Mitsubishi Corp. (55%) and Asahi Chemical Industry Co. Ltd. (10%) and the Indonesian companies PT Parna Raja (25%) and PT Pupuk Kalimantan Timur (10%)] produced its first ammonia in November. After trial production was completed, the company planned to begin commercial production at the 495,000-t/yr plant by January or February 2002 (Fertilizer Week, 2001k).

In March, PT Pupuk Kujang awarded a $250 million contract to Toyo Engineering Corp. to build a 570,000-t/yr ammonia-urea complex. The new plant would replace an existing unit of the same size at the same location, but would be designed to produce urea at a 30% lower energy cost. Completion of the new plant was scheduled for mid-2004 (Nitrogen & Methanol, 2001c).

Iran.—Iran awarded contracts to two companies to construct new nitrogen production capacity. In March, National Petrochemical Co. awarded a contract to Italy's Snamprogetti S.p.A. to build an 1,800-t/d urea granulation plant at its Razi Petrochemical Complex near Bandar Khomeini. Construction was expected to be completed by yearend 2002, and output would be destined for the local market (Fertilizer Week, 2001x). In May, National Petrochemical awarded a $194 million contract to a consortium of Toyo Engineering and Chiyoda Corp. of Japan and local firm PIDEC to build a 2,050-t/d ammonia and 3,250-t/d urea complex. Construction of the complex, which will include one of the world's largest single-stream urea units when completed, was expected to take 39 months. The new complex will be in the Pars petrochemical special economic/energy zone on the northern Arabian Gulf Coast (Fertilizer Week, 2001i).

Kermanshah Petrochemicals Industries Co. was soliciting bids to construct a 660,000-t/yr ammonia-urea complex in Kermanshah. If the plant is built, it would be the first privately owned fertilizer plant in Iran. The projected date of completion is yearend 2004 (Nitrogen & Methanol, 2001g).

Kuwait.—Petrochemical Industries Co. awarded a $89 million contract to Italy's Technimont S.p.A. to convert its remaining prilled urea units to granular urea units. The company's Shuaiba II and III plants would be debottlenecked and converted to granular urea production; the plants' combined capacity would be increased by about 15% to 1,750 t/d. The conversion was scheduled to be completed by November 2002 (Fertilizer Week, 2001s).

Mexico.—Mexico's urea industry remained idle in 2001. The country's urea plants closed in 1999 owing to high ammonia feedstock prices and have not operated since then. According to industry reports, restarting the plants would require either a cost concession from the Government-controlled natural gas producer or ammonia supplier. Mexico's ammonia production costs are equivalent to those in the United States because natural gas prices in Mexico are linked to those in Texas (Fertilizer Markets, 2001d). As a result of the idled capacity, imports of urea into Mexico continued to increase. According to the International Fertilizer Industry Association, imports of urea into Mexico in 2001 were 604 Mt, an increase of 8% from the level in 2000. Most of the urea came from Russia, Ukraine, and the United States (International Fertilizer Industry Association, 2002b, p. 7L-7R).

Nigeria.—National Fertilizer Co. of Nigeria planned to restart its ammonia and urea plants, which have been closed since 1999 owing to maintenance and cash-flow problems. The company has contracted with Kellogg Brown & Root to refurbish the plants; Kellogg Brown & Root was the original builder. The restarted complex is projected to operate at about 70% of its original capacity, which was 230,000 t/yr of ammonia and 347,000 t/yr of urea. No timetable for completion was established (Nitrogen & Methanol, 2001d).

Oman.—Owing to difficulties in finalizing financing and take-or-pay guarantees, completion of Oman-India Fertilizer Co.'s ammonia-urea complex was delayed to early 2005 from its originally scheduled date of 2003. The proposed plant would have capacity of 1.67 Mt/yr of granular urea and 1.2 Mt/yr of ammonia. Oman Oil Co. (50%) and India's Indian Farmers Fertiliser Cooperative (25%) and Krishnak Bharati Cooperative (25%) were the partners in the joint venture. The Indian Government agreed to purchase the plant's full urea production at a predetermined price for 15 years. The total cost of the plant was estimated to be about $1 billion, one-third of which would come from the joint-venture partners, with the remaining two-thirds to come equally from export credit agencies and commercial loans (Fertilizer Week, 2001o).

In July, Bahwan Trading Co. issued invitations to five prequalified contractors to bid on construction of an ammonia-urea complex at Sohar. The 660,000-t/yr ammonia and 1,115,000-t/yr urea complex would be operated by Sohar International Urea & Chemical Industries, and the company has a commitment from the Government of Oman to supply natural gas for 25 years at a competitive price. Common infrastructure facilities for all the industries in the area were being constructed, and Sohar International was negotiating for offtake agreements for the urea production. Two contractors for the project were expected to be selected from the bids by January 2002 (Nitrogen & Methanol, 2001b).

Pakistan.—The Government introduced a fertilizer policy in July that was designed to keep the price of locally produced urea at about 20% less than the cost of imported material. In addition, the policy would provide a feedstock subsidy to companies that are new to the fertilizer industry and to existing manufacturers that begin expansions by 2005. The feedstock subsidy would last 10 years from the plant's commissioning date for the new companies and for a 5-year period for existing manufacturers (Fertilizer Week, 2001q).

Poland.—In January, the Ministry of Treasury invited bids for the privatization of up to 80% of Zaklady Azotowe Kedzierzyn S.A., one of the country's fertilizer producers. In June, the ministry selected Ciech S.A., a marketing company, with a bid of about $12.7 million, but at yearend, the ministry and Ciech were still negotiating (Fertilizer Week, 2001j). The ministry, however, canceled the proposed initial public offering of 35% of Zaklady Azotowe Pulawy S.A. because bids were received for only 500,000 of the available 4.75 million shares (Nitrogen & Methanol, 2001f).

Qatar.—Qatar Fertiliser Co. (Qafco) selected Germany's Krupp Uhde GmbH as the engineering and construction contractor for its Qafco IV expansion at Umm Said. The $420 million contract includes a 2,000-t/d ammonia unit and a 3,500-t/d granular urea unit as well as storage facilities for the products and loading facilities. The ammonia plant will be based on Krupp Uhde's proprietary process, and the urea granulation unit will use Belgium-based Hydro Agri's (a subsidiary of Norsk Hydro) granulation process (Fertilizer Week, 2001l). Construction was scheduled to be completed within 32 months.

Romania.—S.C. Amonil S.A. completed a revamp of its urea and ammonium nitrate plants in the third quarter. The company wanted to restart capacity that had been idle and improve energy consumption rates. The plant has the capacity to produce 77,000 t/yr of urea and 43,000 t/yr of ammonium nitrate (Fertilizer Week, 2001w).

Russia.—TogliottiAzot, Russia's largest ammonia and urea producer, received a $55 million loan from two European development banks to back the company's plans to increase ammonia exports from the Black Sea. With the loan, TogliottiAzot plans to begin construction of a new port northwest of Novorossiysk and one in China (see China section). The company's exports of ammonia have been limited in the past by restrictions imposed by Ukraine on the quantity that can travel in the Yuzhnyy pipeline (Fertilizer Week, 2001y).

In July, the Russian Government approved the privatization of the 21.38% ownership that was held by the Russian Federal Property Fund in the nitrogen producer NevinnomysskAzot. The stake was awarded to MDM Bank Group in August, which brought MDM's total direct and indirect holdings in the company to 47.38%. The plant produces ammonia, urea, UAN, and ammonium nitrate (Fertilizer Week, 2001m).

Saudi Arabia.—In Janaury, SAMAD, a joint venture between Saudi Arabia Basic Industries Co. (Sabic) and Taiwan Fertilizer Co., awarded a contract to Ammonia Casale S.A. to debottleneck its Al-Jubail Fertilizer Co. plant. The project would increase capacity at the plant by 10% to 433,000 t/yr and was expected to be completed by the first quarter of 2002. With the other debottlenecking project underway at Sabic's ammonia plant in ibn al-Baytar that was announced in 2000, Sabic will have an additional 126,000 t/yr of ammonia production capacity when the two projects are completed. This additional ammonia production is expected to feed the new urea capacity that Sabic was constructing at its Safco I plant (Fertilizer Week, 2001u).

Trinidad and Tobago.—Duke Energy Corp. was looking for a buyer for its share of the 645,000-t/yr Caribbean Nitrogen Co. Ltd. ammonia plant in Point Lisas that was under construction. The plant was expected to come on-stream in the first half of 2002. Before the plant construction began, Duke Energy had agreed to market the plant's entire output. By yearend, the company had not found a buyer (Fertilizer Markets, 2001b).

Turkmenistan.—In July, the Government announced that it would sign a contract with Turkish firm GAP Insaatyatirim Ve Dis Ticaret AS to build a nitrogen complex at Tedzhen. The proposed plant would have the capacity to produce 350,000 t/yr of urea and 150,000 t/yr of ammonium nitrate. Construction was expected to be completed by late 2004, and the estimated cost of the plant was $240 million. The state-owned fertilizer producer Turkmendokunkhimiya also planned to reconstruct and modernize its urea-ammonium nitrate plant in Mary. In October, Turkmendokunkhimiya issued a solicitation for bids for the work, which would close in February 2002. After the modernization, capacity at the Mary plant would be increased to 400,000 t/yr each of urea and ammonium nitrate (Fertilizer Week, 2001aa).

Ukraine.—Although the State Property Fund of Ukraine awarded its 53.86% share of nitrogen fertilizer producer RovnoAzot to Ukrzovnishkhimpromholding (a subsidiary of Russia's Gazprom) in May, Ukrzovnishkhimpromholding did not make the required payment of $25 million by the July 15 deadline. As a result, the majority of the plant reverted to state control (Fertilizer Week, 2001t). The Government announced that its tender to sell its 25.17% ownership of nitrogen fertilizer producer DneproAzot was withdrawn because it did not receive any bids by the scheduled deadline of September 15. Bidders would have been required to pay an outstanding tax bill and to submit a proposal for modernization of the plant (Fertilizer Week, 2001n).

Uzbekistan.—The Uzbekistan State Property Committee set up an organization, Uzhkhimprom, to manage the privatization of the country's fertilizer operations over the next 5 years. The nitrogen producers that were scheduled to be privatized are PO Azot Fergana, Navoi Azot, and Chirchik Production Association. Ownership of between 45% and 49% in these companies would be offered to domestic and foreign investors, with the Government retaining at least a 51% share (Fertilizer Week, 2001bb).

Vietnam.—The Government approved a plan by the state-owned oil and gas company Vietnam Oil and Gas Corp. (Petrovietnam), to build an 800,000-t/yr urea plant in Phu My. The plan was based on a feasibility study that revised earlier studies submitted by Technip-Coflexip based on a gas supply from the White Tiger gasfield. The project, when first proposed several years ago, was a joint venture among several firms but was delayed because Petrovietnam was unable to finalize gas supply and price issues with its foreign partners in the joint venture (Nitrogen & Methanol, 2001a). No timetable was set for plant construction.

Current Research and Technology

American Electric Power Co. Inc. (AEP) announced that it will use Environmental Elements Corp.'s Ammonia on Demand® (AOD) technology to reduce NOx emissions at the company's General James M. Gavin powerplant at Cheshire, OH. The Gavin plant consists of two 1,300-megawatt (MW) coal-fired generating units and is the largest generating station in Ohio. The AOD system enables the immediate conversion of urea into ammonia. Ammonia is added to the powerplant's exhaust gases, which are then channeled through a catalyst that breaks down the gases into elemental nitrogen and water. The urea-based system eliminates the need to store large quantities of ammonia at the plant site. (Ammonia storage requires refrigeration equipment whereas urea storage does not.) The agreement between AEP and Environmental Elements also establishes Environmental Elements as the exclusive supplier of urea-to-ammonia systems for AEP if the company decides to proceed with additional installations of the technology. In addition, the agreement grants AEP an exclusive sublicense to market and sell the urea-to-ammonia systems throughout North America (Green Markets, 2001a). Later in the year, AEP decided to install the urea-based systems on some of its powerplants in Kentucky, Ohio, and West Virginia. (AEP owns and operates more than 38,000 MW of generating capacity in the U.S. international markets.) As more coal-burning powerplants are required to meet new air pollution requirements, they could provide an additional end use for urea or ammonia, depending on the technology used at individual plants.

In March, ThermoEnergy Corp. concluded a demonstration of its sludge-to-oil reactor system (STORS) project in Colton, CA, sponsored by the U.S. Environmental Protection Agency. This $3 million demonstration confirmed the ability of the STORS process to convert raw sewage sludge (biosolids) into biofuel. Water from the STORS system will be treated by ThermoEnergy's ammonia recovery process (ARP), which removes ammonia from the water, converting it to ammonium sulfate. Biofuel can either be used on-site to power the STORS/ARP plant or sold to the local electricity power market. ThermoEnergy claims that additional benefits of the new process include improved nitrogen removal efficiency, reduction or elimination of odor control problems, and phosphorus removal from the discharge stream (Green Markets, 2001h).

Outlook

According to the U.S. Department of Agriculture (USDA), planting intentions for the 2002 crop year were estimated to be 100.5 million hectares. Although this acreage was more than 1.2 million hectares less than the 2001 planting intentions, it was nearly identical to the actual planted acreage for 2001. Planting intentions for 2002 were 3.5 million hectares below the most recent peak of 1996. Intended corn plantings were up in part because nitrogen fertilizer costs were lower than those in 2000. Also contributing to expanded corn planting intentions were changes in relative commodity prices and other factors, such as crop rotation considerations and disappointing soybean yields in recent years. Farmers intended to expand planted corn acreage by about 4% from 2001 to 32 million hectares. Soybean plantings were expected to be down 0.45 million hectares to 29.5 million hectares (Agricultural Outlook, 2002).

In the longer term, the USDA projected that after a decline in planted acreage in the beginning of the decade, corn plantings would increase slightly by 2012, projecting a planted acreage of 32.3 million hectares compared with 30.8 million hectares in 2001 (figure 6). Wheat and soybeans followed a similar pattern, with wheat plantings projected to grow to 25.9 million hectares from 24.1 million hectares, and soybeans projected to grow to 30.9 million hectares from 30.4 million hectares (U.S. Department of Agriculture, Economic Research Service, 2002§). If these projections are correct, then U.S. consumption of nitrogen for fertilizer applications is likely to increase.

As natural gas prices eased in the United States, idled ammonia capacity returned to production, and ammonia prices declined. In the longer term, however, small, inefficient, poorly located plants around the world are expected to close. Production capacity is expected to increase in areas that are close to natural gasfields, such as the Middle East and the Caribbean. If significant capacity increases occur in the Caribbean region, then a nearby supply of cheaper ammonia may result in increases in imports to the United States at the expense of domestic production.

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TABLE 1
SALIENT AMMONIA STATISTICS 1/ 2/

(Thousand metric tons of contained nitrogen, unless otherwise specified)

	1997	1998	1999	2000	2001
United States:					
Production	13,300	13,800	12,900	12,500 r/	9,730 p/
Exports	395	614	562	662	647
Imports for consumption	3,530	3,460	3,890	3,880	4,550
Consumption, apparent 3/	15,800	17,100	16,300	15,600 r/	13,800 p/
Stocks, December 31, producers'	1,530	1,050	996 4/	1,120 4/	916 4/
Average annual price per metric ton product, f.o.b. Gulf Coast 5/	$173	$121	$109	$169	$183
Net import reliance as a percentage of apparent consumption 6/	16	19	21	20	30 p/
Natural gas price, wellhead 7/	$2.32	$1.96 r/	$2.19 r/	$3.69 r/	$4.12 e/
World:					
Production	103,000	104,000 r/	108,000 r/	109,000	106,000 p/
Trade 8/	11,300	11,300	12,000	12,700 r/	12,600 p/

e/ Estimated. p/ Preliminary. r/ Revised.
1/ Data are rounded to no more than three significant digits, except prices.
2/ Synthetic anhydrous ammonia, calendar year data, the U.S. Census Bureau; excludes coke oven byproduct.
3/ Calculated from production plus imports minus exports and industry stock changes.
4/ Source: The Fertilizer Institute.
5/ Source: Green Markets.
6/ Net import reliance is defined as imports minus exports, adjusted for industry stock changes.
7/ Monthly Energy Review, U.S. Department of Energy. Average annual cost at wellhead in dollars per thousand cubic feet.
8/ Source: International Fertilizer Industry Association Statistics, World Anhydrous Ammonia Trade.

TABLE 2
FIXED NITROGEN PRODUCTION IN THE UNITED STATES 1/

(Thousand metric tons of contained nitrogen)

	2000 r/	2001 p/
Anhydrous ammonia, synthetic:		
Fertilizer	11,000	8,590
Nonfertilizer	1,510	1,140
Total	12,500	9,730

p/ Preliminary. r/ Revised.
1/ Data are rounded to no more than three significant digits; may not add to totals shown.

Sources: U.S. Census Bureau, Current Industrial Reports MA325B and MQ325B.

TABLE 3
MAJOR DOWNSTREAM NITROGEN COMPOUNDS
PRODUCED IN THE UNITED STATES 1/ 2/

(Thousand metric tons)

Compound	2000	2001 p/
Urea:		
Gross weight	6,910 r/	6,390
Nitrogen content	3,170 r/	2,930
Ammonium phosphates: e/ 3/		
Gross weight	15,900 r/	14,700
Nitrogen content	2,550 r/	2,280
Ammonium nitrate:		
Gross weight	6,800 r/	6,440
Nitrogen content	2,310 r/	2,180
Nitric acid:		
Gross weight	7,690 r/	7,100
Nitrogen content	1,690 r/	1,560
Ammonium sulfate: 4/		
Gross weight	2,600	2,320
Nitrogen content	552	492

See footnotes at end of table.

TABLE 3--Continued
MAJOR DOWNSTREAM NITROGEN COMPOUNDS
PRODUCED IN THE UNITED STATES 1/ 2/

e/ Estimated. p/ Preliminary. r/ Revised.
1/ Data are rounded to no more than three significant digits.
2/ Ranked in relative order of importance by nitrogen content.
3/ Diammonium phosphate (DAP), monoammonium phosphate (MAP), and other ammonium phosphates.
4/ Excludes coke plant ammonium sulfate.

Source: U.S. Census Bureau, Current Industrial Reports MQ325B.

TABLE 4
DOMESTIC PRODUCERS OF ANHYDROUS AMMONIA IN 2001 1/

(Thousand metric tons per year of ammonia)

Company	Location	Capacity 2/
Agrium Inc.	Borger, TX	490
Do.	Finley, WA	180
Do.	Kenai, AK	1,250
Air Products and Chemicals Inc.	Pace Junction, FL	71
Avondale Ammonia Co. (Cytec Industries Inc.)	Fortier, LA 3/	399
CF Industries Inc.	Donaldsonville, LA	2,000
Coastal Chem Inc. 4/	Cheyenne, WY	235
Coastal Refining and Marketing Inc. 4/	Freeport, TX	204
Coastal St. Helens Chemical 4/	St. Helens, OR	91
Dakota Gasification Co.	Beulah, ND	363
E.I. du Pont de Nemours & Co.	Beaumont, TX 5/	496
El Dorado Chemical Co.	Cherokee, AL	175
Farmland Industries Inc.	Beatrice, NE	272
Do.	Coffeyville, KS	350
Do.	Dodge City, KS	281
Do.	Enid, OK	907
Do.	Fort Dodge, IA	339
Do.	Lawrence, KS	420
Do.	Pollock, LA	470
Green Valley Chemical Corp.	Creston, IA	32
Honeywell International Inc.	Hopewell, VA	409
IMC-Agrico Co.	Faustina (Donaldsonville), LA	508
J.R. Simplot Co.	Pocatello, ID	93
Koch Nitrogen Co.	Sterlington, LA	998
MissChem Nitrogen LLC 6/	Yazoo City, MS	621
Nitromite Fertilizer	Dumas, TX	128
PCS Nitrogen Inc.	Augusta, GA	651
Do.	Geismar, LA	525
Do.	Lima, OH	542
Do.	Woodstock, TN	409
Royster-Clark Inc.	East Dubuque, IL	278
Shoreline Chemical	Gordon, GA	31
Terra Industries Inc.	Beaumont, TX	231
Do.	Blytheville, AR	381
Do.	Port Neal, IA	336
Do.	Verdigris, OK	953
Do.	Woodward, OK	399
Triad Nitrogen LLC 6/	Donaldsonville (Ampro), LA	524
Do.	Donaldsonville (Triad), LA	422
Total		17,500

1/ Data are rounded to no more than three significant digits; may not add to total shown.
2/ Engineering design capacity adjusted for 340 days per year of effective production capability.
3/ Indefinitely mothballed in April 2001.
4/ Subsidiary of El Paso Corp.
5/ Closed in June 2001.
6/ Wholly owned subsidiary of Mississippi Chemical Corp.

Sources: International Fertilizer Development Center (IFDC) and company web sites.

TABLE 5
U.S. NITROGEN FERTILIZER CONSUMPTION,
BY PRODUCT TYPE 1/ 2/

(Thousand metric tons nitrogen)

Fertilizer material 3/	2000	2001 p/
Single nutrient:		
Anhydrous ammonia	4,450 r/	3,630
Nitrogen solutions 4/	2,830 r/	2,590
Urea	1,970 r/	2,090
Ammonium nitrate	524 r/	480
Ammonium sulfate	201 r/	210
Aqua ammonia	64	64
Other 5/	285	306
Total	10,300 r/	9,360
Multiple nutrient 6/	2,130 r/	2,090
Grand total	12,500 r/	11,500

p/ Preliminary. r/ Revised.
1/ Data are rounded to no more than three significant digits; may not add to totals shown.
2/ Fertilizer years ending June 30.
3/ Ranked in relative order of importance by product type.
4/ Principally urea-ammonium nitrate (UAN) solutions, 29.9% nitrogen.
5/ Includes other single-nutrient nitrogen materials, all natural organics, and statistical discrepancies.
6/ Various combinations of nitrogen (N), phosphate (P), and potassium (K): N-P-K, N-P, and N-K.

Source: Commercial Fertilizers 2001. Prepared as a cooperative effort by The Fertilizer Institute and the Association of American Plant Food Control Officials.

TABLE 6
U.S. PRODUCER STOCKS OF FIXED NITROGEN
COMPOUNDS AT YEAREND 1/ 2/

(Thousand metric tons nitrogen)

Material 3/	2000	2001 p/
Ammonia 4/	1,120	916
Nitrogen solutions 5/	128	181
Urea	50 r/	117
Ammonium phosphates 6/	50 r/	83
Ammonium nitrate	35	46
Ammonium sulfate	25	31
Total	1,400 r/	1,370

p/ Preliminary. r/ Revised.
1/ Data are rounded to no more than three significant digits; may not add to totals shown.
2/ Calendar year ending December 31.
3/ Ranked in relative order of importance.
4/ Source: The Fertilizer Institute.
5/ Urea-ammonium nitrate and ammoniacal solutions.
6/ Diammonium and monoammonium phosphates.

Source: U.S. Census Bureau, Current Industrial Reports MQ325B, except where noted.

TABLE 7
PRICE QUOTATIONS FOR MAJOR NITROGEN COMPOUNDS AT YEAREND

(Dollars per short ton)

Compound	2000	2001
Ammonium nitrate; f.o.b. Corn Belt 1/	140-150	120-130
Ammonium sulfate; f.o.b. Corn Belt 1/	130-135	124-129
Anhydrous ammonia:		
F.o.b. Corn Belt	280-300	170-180
F.o.b. Gulf Coast 2/	230	125
Diammonium phosphate; f.o.b. central Florida	137-142	133-140
Urea:		
F.o.b. Corn Belt, prilled and granular	175-180	130-135
F.o.b. Gulf Coast, granular 2/	158-161	104-108
F.o.b. Gulf Coast, prilled 2/	150-155	103-105

1/ Illinois, Indiana, Iowa, Missouri, Nebraska, and Ohio.
2/ Barge, New Orleans.

Source: Green Markets.

TABLE 8
U.S. EXPORTS OF ANHYDROUS AMMONIA,
BY COUNTRY 1/

(Thousand metric tons ammonia)

Country	2000	2001
Brazil	17	(2/)
Canada	18	47
Japan	18	2
Korea, Republic of	645	542
Mexico	67	95
South Africa	18	1
Taiwan	2	86
Other	20	14
Total	805	787

1/ Value data suppressed by U.S. Census Bureau.
2/ Less than 1/2 unit.

Source: U.S. Census Bureau.

TABLE 9
U.S. IMPORTS OF ANHYDROUS AMMONIA, BY COUNTRY 1/

(Thousand metric tons ammonia and thousand dollars)

Country	2000 Gross weight	2000 Value 2/	2001 Gross weight	2001 Value 2/
Argentina	--	--	28	5,710
Canada	1,050	201,000	802	171,000
Colombia	46	6,340	66	11,000
Indonesia	97	14,900	139	27,100
Italy	--	--	(3/)	19
Japan	2	175	2	200
Kuwait	--	--	23	3,430
Latvia	--	--	80	17,500
Lithuania	21	1,790	--	--
Malaysia	--	--	6	1,440
Mexico	148	21,900	--	--
Netherlands	11	1,820	--	--
Norway	--	--	20	4,720
Russia	908 4/	48,500	336	58,500
Saudi Arabia	--	--	59	13,000
Trinidad and Tobago	2,430	384,000	2,880	455,000
Ukraine	NA	85,600	858	184,000
Venezuela	9	1,430	242	40,300
Total	4,720	768,000	5,540	992,000

NA Not available. -- Zero.
1/ Data are rounded to no more than three significant digits; may not add to totals shown.
2/ C.i.f. value.
3/ Less than 1/2 unit.
4/ Quantity data from the Journal of Commerce Port Import/Export Reporting Service; may include imports from Ukraine.

Sources: U.S. Census Bureau, Journal of Commerce Port Import/Export Reporting Service.

TABLE 10
U.S. EXPORTS OF MAJOR NITROGEN COMPOUNDS 1/

(Thousand metric tons)

Compound	2000 Gross weight	2000 Nitrogen content	2001 Gross weight	2001 Nitrogen content	Principal destinations, 2001
Ammonium nitrate 2/	22	7	19	6	Mexico, 61%; Canada, 34%.
Ammonium sulfate 2/	983	265	668	180	Brazil, 50%; Dominican Republic, 12%.
Anhydrous ammonia	805	662	787	647	Republic of Korea, 69%; Taiwan, 11%.
Diammonium phosphate	7,620	1,370	6,410	1,150	China, 45%.
Monoammonium phosphate	2,300	253	2,580	284	Brazil, 29%; Canada, 25%; Australia, 21%.
Urea	663	304	792	364	Mexico, 36%; Thailand, 20%; Canada, 18%.
Mixed chemical fertilizers 3/	273	33	406	49	Colombia, 28%; Mexico, 18%, Japan, 11%.
Other nitrogenous fertilizers 4/	207	61	157	46	Mexico, 19%; Canada, 12%.
Total	12,900	2,960	11,800	2,730	

1/ Data are rounded to no more than three significant digits; may not add to totals shown.
2/ Includes industrial chemical products.
3/ Harmonized codes 3105.10.0000, 3105.20.0000, and 3105.51.0000.
4/ Harmonized codes 3101.00.0000, 3102.29.0000, 3102.60.0000, and 3102.90.0000.

Source: U.S. Census Bureau.

TABLE 11
U.S. IMPORTS OF MAJOR NITROGEN COMPOUNDS 1/

(Thousand metric tons and thousand dollars)

Compound	2000 Gross weight	2000 Nitrogen content	2000 Value 2/	2001 Gross weight	2001 Nitrogen content	2001 Value 2/	Principal sources, 2001
Ammonium nitrate 3/	818	277	93,700	953	323	127,000	Canada, 54%.
Ammonium nitrate-limestone mixtures	1	(4/)	173	1	(4/)	87	Canada, 83%.
Ammonium sulfate 3/	347	74	32,400	335	71	28,700	Canada, 67%.
Anhydrous ammonia 5/	4,720	3,880	768,000	5,540	4,550	992,000	Trinidad and Tobago, 52%; Ukraine, 15%; Canada, 14%.
Calcium nitrate	(4/)	(4/)	9,890	(4/)	(4/)	12,900	Norway, 94%.
Diammonium phosphate	123	22	21,900	133	24	22,300	Russia, 95%.
Monoammonium phosphate	188	21	40,700	262	29	48,600	Russia, 89%.
Nitrogen solutions	1,310	390	129,000	2,000	597	235,000	Russia, 33%; Ukraine, 16%; Canada, 11%; Lithuania, 10%.
Potassium nitrate	41	6	13,700	51	7	14,900	Chile, 85%.
Potassium nitrate-sodium nitrate mixtures	9	1	1,660	15	2	2,920	Chile, 99%.
Sodium nitrate	98	16	20,100	92	15	17,800	Chile, 95%.
Urea	3,900	1,790	621,000	4,800	2,200	773,000	Canada, 31%; Saudi Arabia, 12%.
Mixed chemical fertilizers 6/	257	31	61,500	317	38	73,200	Morocco, 30%; Russia, 19%; Norway, 16%; Canada, 15%.
Other nitrogenous fertilizers 7/	207	61	39,500	194	57	35,700	Norway, 82%.
Total	12,000	6,570	1,850,000	14,700	7,920	2,380,000	

1/ Data are rounded to no more than three significant digits; may not add to totals shown.
2/ C.i.f. value
3/ Includes industrial chemical products.
4/ Less than 1/2 unit.
5/ Includes industrial ammonia.
6/ Harmonized codes 3105.10.0000, 3105.20.0000, 3105.51.0000, and 3105.90.0050.
7/ Harmonized codes 3101.00.0000, 3102.29.0000, 3102.60.0000, and 3102.90.0000.

Source: U.S. Census Bureau.

TABLE 12
AMMONIA: WORLD PRODUCTION, BY COUNTRY 1/ 2/

(Thousand metric tons of contained nitrogen)

Country	1997	1998	1999	2000	2001 p/
Afghanistan e/	5	5	5	5	5
Albania e/	10	10	10	10	10
Algeria	379 r/	350	455	458	469
Argentina	107	86	88	199	597 3/
Australia	432	435	431	576	762 3/
Austria e/	450	450	450	450 r/	460
Bahrain	356	336	370	350	372
Bangladesh 4/	1,080	1,129	1,240	1,255	1,270
Belarus	590 e/	685	765	730	725
Belgium	760	756	840	863	788
Bosnia and Herzegovina e/	1	1	1	1	1
Brazil	1,019	949	1,084	925	769
Bulgaria	808	448	315	533	477
Burma	62	52	66	78	28
Canada	4,081	3,900	4,135	4,130	3,439 3/
China	24,700 r/	25,800 r/	28,300 r/	27,700 r/	28,100 3/
Colombia	81	100	75	93	95 3/
Croatia	331	248	318	325	259
Cuba e/	135	135	135	135	135
Czech Republic	251	258	223	246	206
Denmark e/	2	2	2	2	2
Egypt	1,061	1,141	1,407	1,511	1,800
Estonia	153	175	164 r/	145 r/	151

See footnotes at end of table.

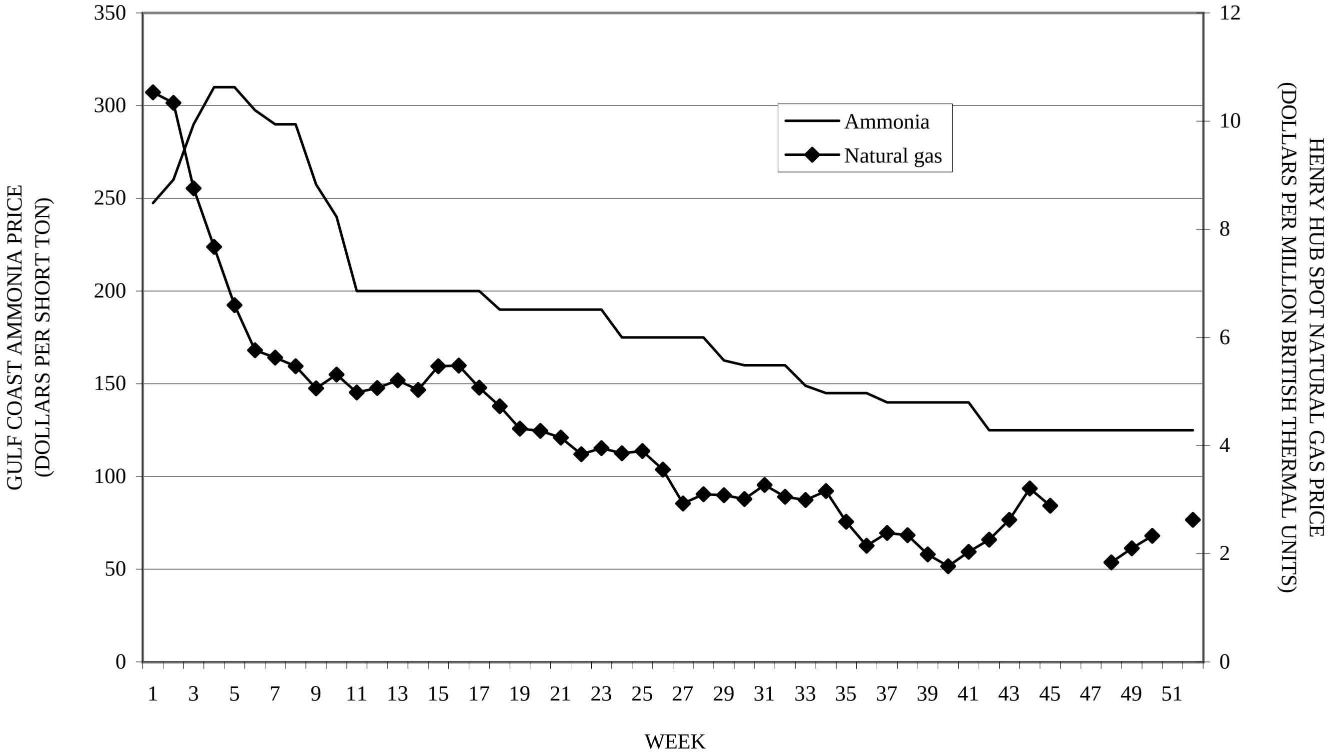
TABLE 12--Continued
AMMONIA: WORLD PRODUCTION, BY COUNTRY 1/ 2/

(Thousand metric tons of contained nitrogen)

Country	1997		1998		1999		2000		2001 p/	
Finland e/	6		6		6		6		6	
France e/	1,757	3/	1,570		1,580	r/	1,620	r/	1,580	
Germany	2,471	r/	2,512		2,406		2,473		2,730	
Georgia	84		64		104		135	r/	60	
Greece	83	e/	178		160		121		57	
Hungary	339		288		261		352		324	
Iceland	7		6		7	e/	7	e/	3	
India 5/	9,328		10,240		10,376		10,148		10,100	
Indonesia	3,769		3,600		3,450		3,620	r/	3,700	
Iran	880		1,034		865		965		1,090	
Iraq e/	220		220		220		200	r/	200	
Ireland	465		458		405		410		443	
Israel 4/	57		1		--		--		--	
Italy	446		409		367		408		434	3/
Japan	1,509		1,389		1,385		1,410	r/	1,318	3/
Kazakhstan e/	75		--		--		--		--	
Korea, North e/	600		600		500		450		450	
Korea, Republic of	526		496		489		400	e/	420	
Kuwait	432		452		397		410		400	
Libya	537		545		552		552		495	
Lithuania	467		407		401		420		440	
Malaysia	243		351		432	e/	605		726	
Mexico	1,448		1,449		1,003		701		548	3/
Netherlands e/	2,478	3/	2,350		2,430		2,540		1,940	
New Zealand	80		94		110		105		117	
Nigeria e/	134		168		148		--		--	
Norway	279		245		122		334		323	
Pakistan	1,549		1,797		1,999		1,884		1,970	
Peru	15	e/	15	e/	--		--		--	
Poland	1,824		1,683		1,474		1,862		1,740	
Portugal	196		204		223		246		202	
Qatar	943		1,127		1,130		1,097		1,160	
Romania	781		378		686		1,016		949	
Russia	7,150		6,500		7,633		8,735		8,685	3/
Saudi Arabia	1,405		1,418		1,402		1,743		1,770	
Serbia and Montenegro	235		172		57		60	r/ e/	66	
Slovakia	229		234		247	r/	271		215	
South Africa	752		723		785		560		500	
Spain	497		460		437		442		436	
Switzerland	32		31		32		33		31	3/
Syria	84		129		112		91		138	
Taiwan	289		231		146		11		--	
Tajikistan e/	10		10		10		10		10	
Trinidad and Tobago	1,772		2,271		2,720		2,686		3,043	3/
Turkey	558		560		82		53		67	
Turkmenistan e/	61	3/	75		75		75		75	
Ukraine	3,400	e/	3,300		3,711		3,577		3,700	
United Arab Emirates	373		331		380		348		358	
United Kingdom	642		871		902		814		850	
United States 6/	13,300		13,800		12,900		12,500	r/	9,730	3/
Uzbekistan	950		875		790		810		670	
Venezuela	612		522		522		377		807	3/
Vietnam	54		33		33	e/	42		53	
Zambia e/	1		--		--		--		--	
Zimbabwe e/	64		57		61		58		58	
Total	103,000		104,000	r/	108,000	r/	109,000		106,000	

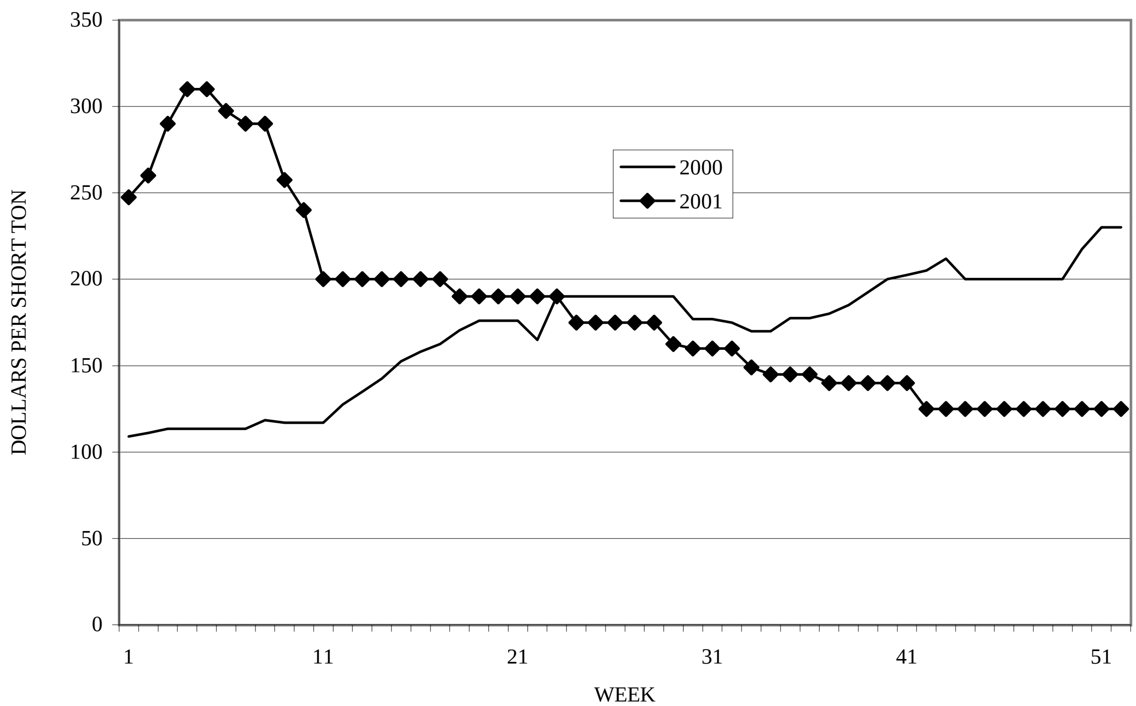
e/ Estimated. p/ Preliminary. r/ Revised. -- Zero.
1/ World totals, U.S. data, and estimated data are rounded to no more than three significant digits; may not add to totals shown.
2/ Table includes data available through June 18, 2002.
3/ Reported figure.
4/ May include nitrogen content of urea.
5/ Data are for years beginning April 1 of that stated.
6/ Synthetic anhydrous ammonia; excludes coke oven byproduct ammonia.

FIGURE 1
AMMONIA AND NATURAL GAS PRICES IN 2001



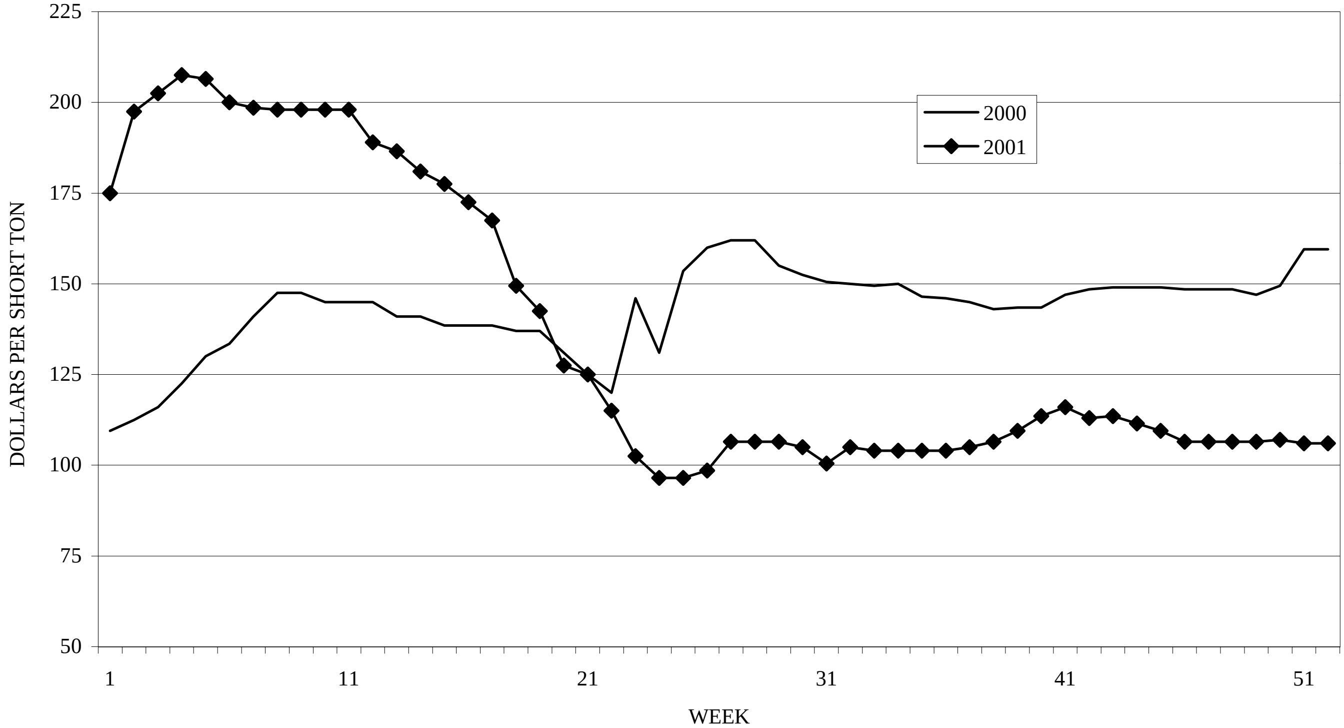
Note: Natural gas prices for weeks 46, 47, and 51 were not available.

FIGURE 2
AVERAGE GULF COAST AMMONIA PRICES



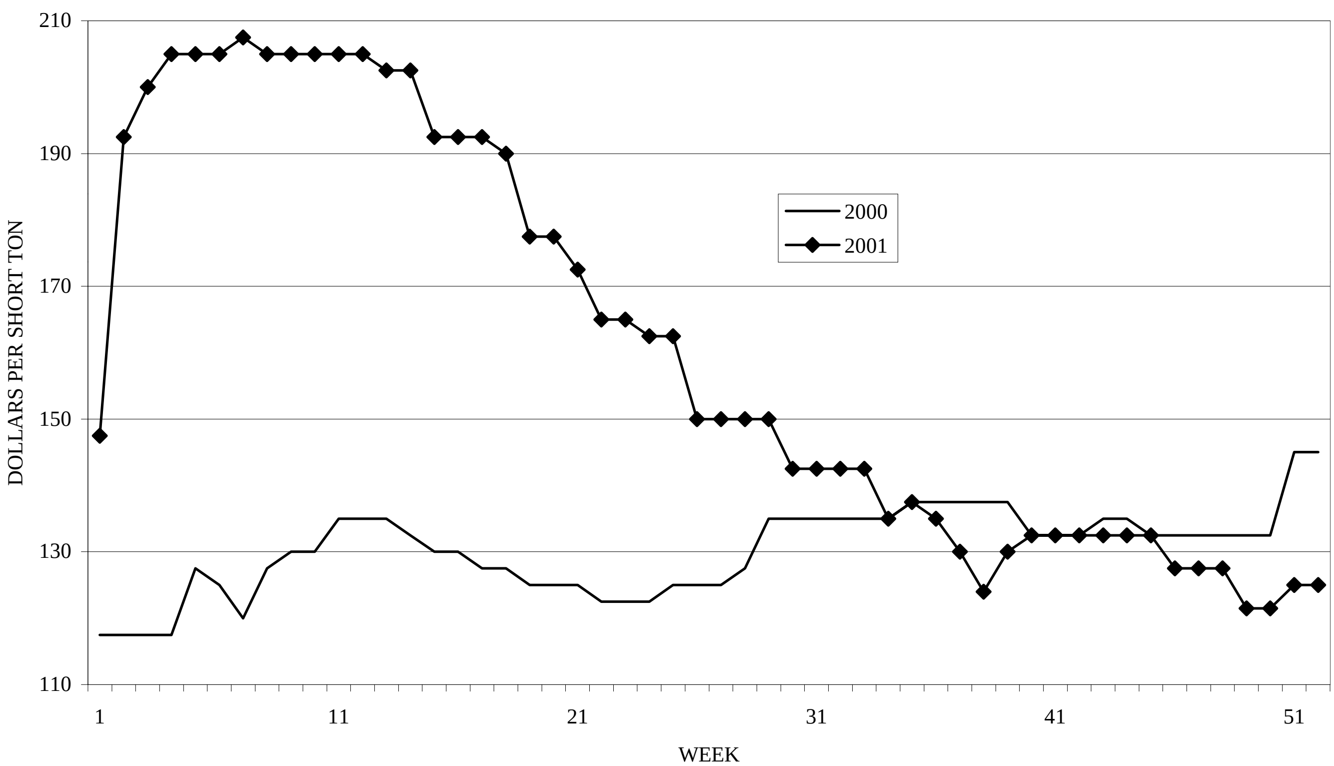
Source: Green Markets.

FIGURE 3
AVERAGE GULF COAST GRANULAR UREA PRICES



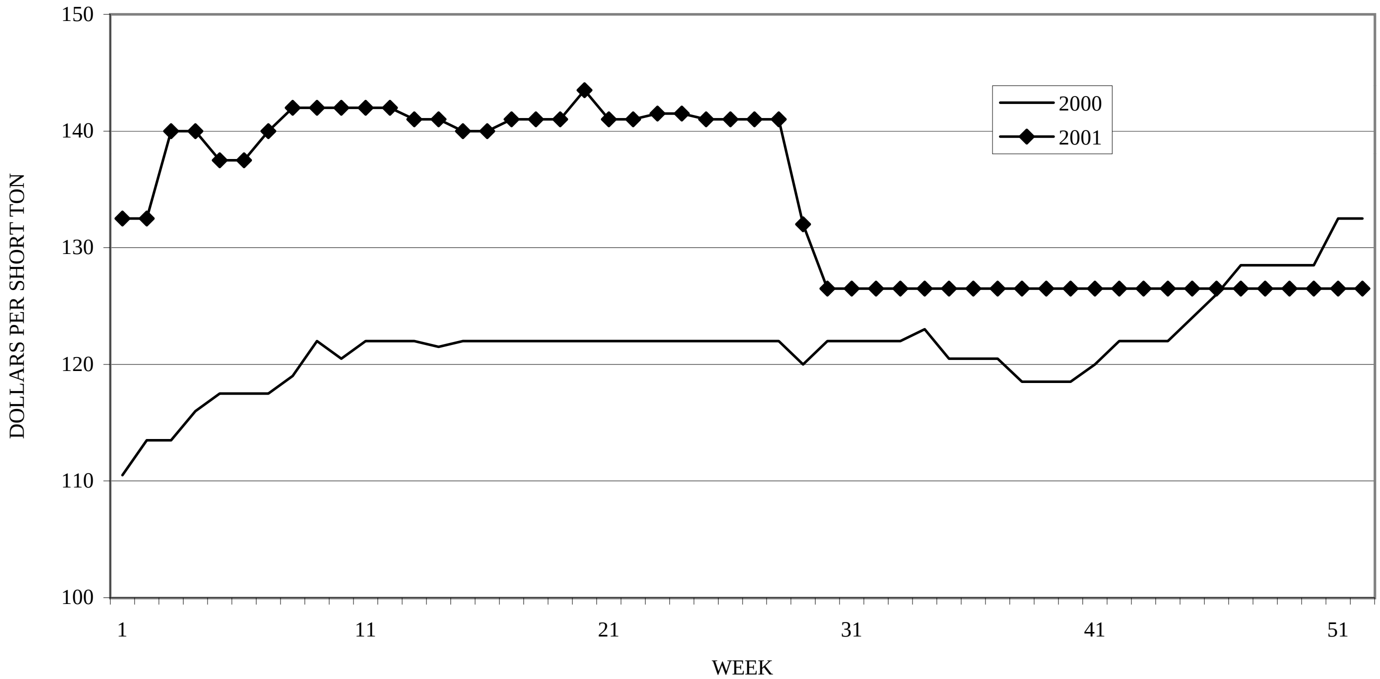
Source: Green Markets.

FIGURE 4
AVERAGE AMMONIUM NITRATE PRICES



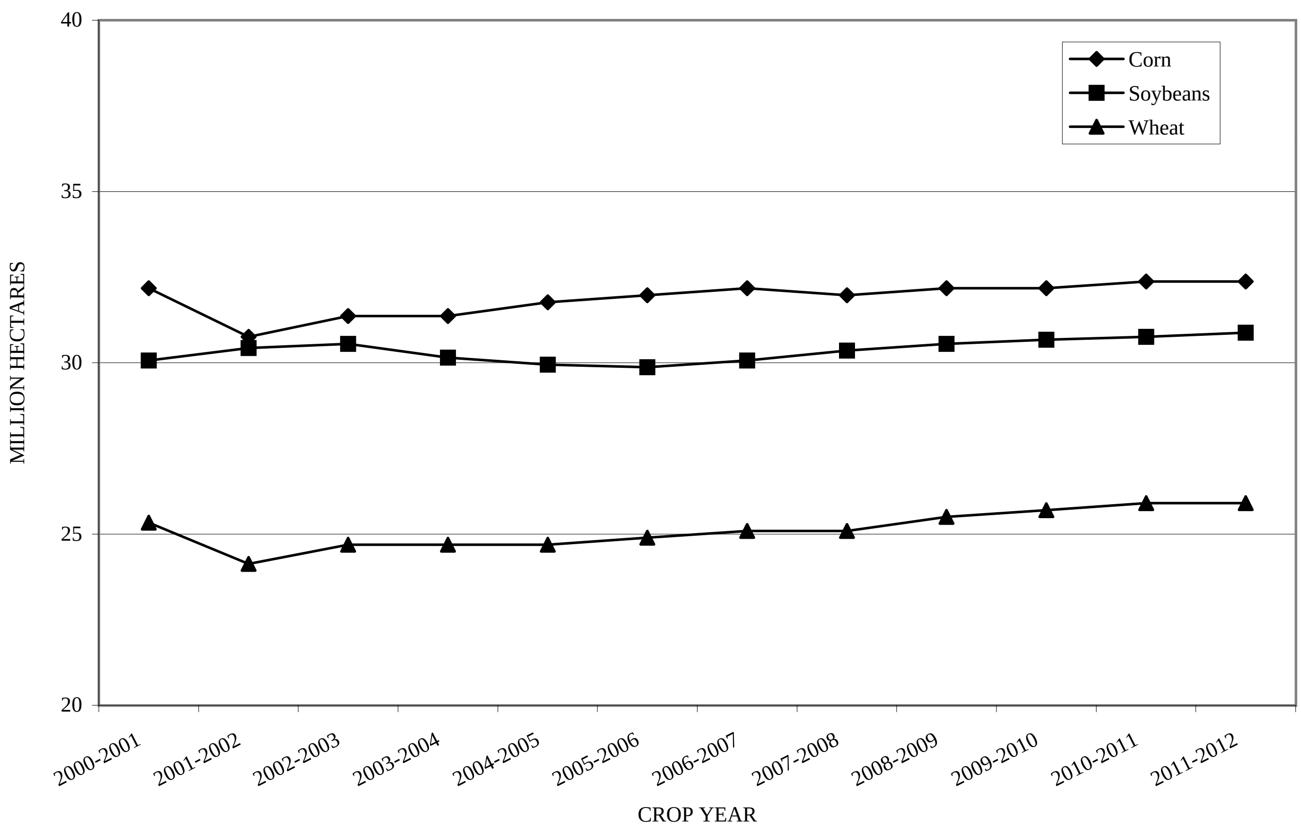
Source: Green Markets

FIGURE 5
AVERAGE AMMONIUM SULFATE PRICES



Source: Green Markets.

FIGURE 6
PROJECTED PLANTED ACREAGE



Source: U.S. Department of Agriculture.