ENIGMA
MARKETING RESEARCH

Westfields House
2 Woodlands Drive
Goostrey, Cheshire
CW4 8JH, U.K.
Tel: +44 (0)1477 544056
Fax: +44(0)1477533346

Agrochemical Pricing Outlook 2008

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Contact Dr Nigel Uttley
E-mail: nigel.uttley@enigmamarketingresearch.com
www.enigmamarketingresearch.com

Agrochemical Pricing Outlook – 2008

Agrochemicals, also known as pesticides or crop protection chemicals, are chemicals manufactured from a wide range of organic and inorganic commodity chemicals and used to control pests, including weeds, insects and fungi. The global market for agrochemicals is valued at around US$50 billion, with about two thirds of this coming from crop protection products (US$35 billion) and one third from non-crop (US$15 billion) uses, such as forestry, public health and industrial uses.

In early 2006 Enigma Marketing Research published a report on the outlook for agrochemical pricing in response to the dramatic increases in world oil (approximately US$70/barrel) and gas prices experienced at the time. Our report concluded that further pricing pressures from higher raw material, energy and transportation costs were likely to impact crop protection chemicals in 2007 and 2008.

Revisiting the subject in 2008, we find the agrochemicals market buoyant despite continued increases in the oil and gas prices. This updated review analyses the factors driving current growth and optimism and considers what the future may hold for pricing trends.

Demand for Agrochemicals

Demand for agrochemicals is notoriously multi-factorial with the weather, crop types, weed types, farming intensity, soil characteristics, sowing techniques, planting density and application rates all combining to give enormous regional and year-on-year variation. However, after several years of low growth or decline, demand for both crop and non-crop products enjoyed significantly positive rates of 10% and 5% per annum respectively in 2007. Industry analysts expect good growth to continue at an average of 3% per annum for crop protection products over the next 5 years based on the following key demand drivers:

- **Increasing numbers of mouths to feed** Population demographics are well documented. By 2050, UN projections estimate that the global population will be over 9 billion, 38% more than today, and food requirements will have doubled as not only are there more people to feed but more will live in urban areas. Food shortages have become a global issue: global grain consumption has exceeded production over the last decade. Shortages have produced higher prices and prompted several producing countries, such as India, Vietnam, and China, to limit or ban exports of food crops. These export restrictions are considered by the Director General of the World Trade Organisation, Pascal Lamy, to ‘fuel the fire of food price rises’. In Argentina, proposals to increase export taxes on grains caused political turmoil and were finally defeated in July this year due to farmers’ protests.

- **Growing affluence** Increases in per capita income, as reflected by growing GDPs, especially in developing countries, is leading to increases in the amount of food eaten per capita. Diets also change with increasing affluence for example, a rise in protein intake, especially meat, consumption (meat production requires grain to be fed to animals, for example, 7kg grain will produce 1kg of beef, and so the demand for grain is also increased) and an increase in the demand for fresh fruit and vegetables (which consume approximately 25% of the demand for crop agrochemicals) is rising.

- **Biofuels** Many countries are trying to reduce dependence on oil as a fuel and to decrease polluting gas emissions, giving rise to a trend to produce renewable energy from crops. Demand for biofuels grew by 15% in 2007 and is expected to continue as governments in the US and EU have set ambitious targets for the next 12 and 14 years respectively. Biofuels produced currently are mainly ethanol and agro-diesel which are derived from corn (maize), sugar cane, rapeseed oil, soybean and palm oil with small amounts of wheat. About 20% of the US corn crop is now used for ethanol production compared with just 3% four years ago. Brazil uses around 54% of its sugar cane crop to produce ethanol and now 91% of new car sales are the ‘flex’ fuel (first launched in 2003) type and India has a 2012 target for 5% of fuel use to be biofuel.

- **Regulatory environment incentivising increased crop production** Examples of this include: the EU removing its 10% set-aside subsidy and the US providing biofuel subsidies.

These underlying drivers have resulted in high acreages being planted for crops and high crop prices, for example the price of corn in the US rose some 190% to US$7.50 per bushel from January 2006 to July 2008 and soybeans by 130% in the same period. High prices for crops have, in turn, translated into high farm incomes giving farmers a financial incentive to increase crop output further. Although more land is being planted, there are constraints in many areas so farmers seek to improve yield per acre through optimal application of fertilisers and crop protection products. Pesticide use varies considerably with crop type, seed type and conditions, however, on average it represents less than 10% of farmers' total fixed and variable costs, so increased use of pesticides can be a cost-efficient way of improving overall income.

Supply/Manufacture of Agrochemicals

Crude oil and natural gas are the principal feedstocks for the organic commodity chemicals used by both agrochemical manufacturers and those making intermediate chemicals, which are sold to the agrochemical manufacturers and/or formulators. Inorganic chemicals derived from mineral ores and brines are essential as the sources of key elements, such as phosphorus, chlorine, fluorine and sulphur, in agrochemical active substances.

Figure 1 illustrates how crude oil and natural gas are transformed into the basic organic building blocks of the chemical industry. Figure 2 shows how the various classes of chemicals are used in the agrochemical manufacturing chain, giving some quantification of the compounds involved at each stage.

Some specific manufacturing pathways of selected agrochemical active substances, including glyphosate, are considered later in this review.

Figure 1: Basic Chemical Manufacturing Processes

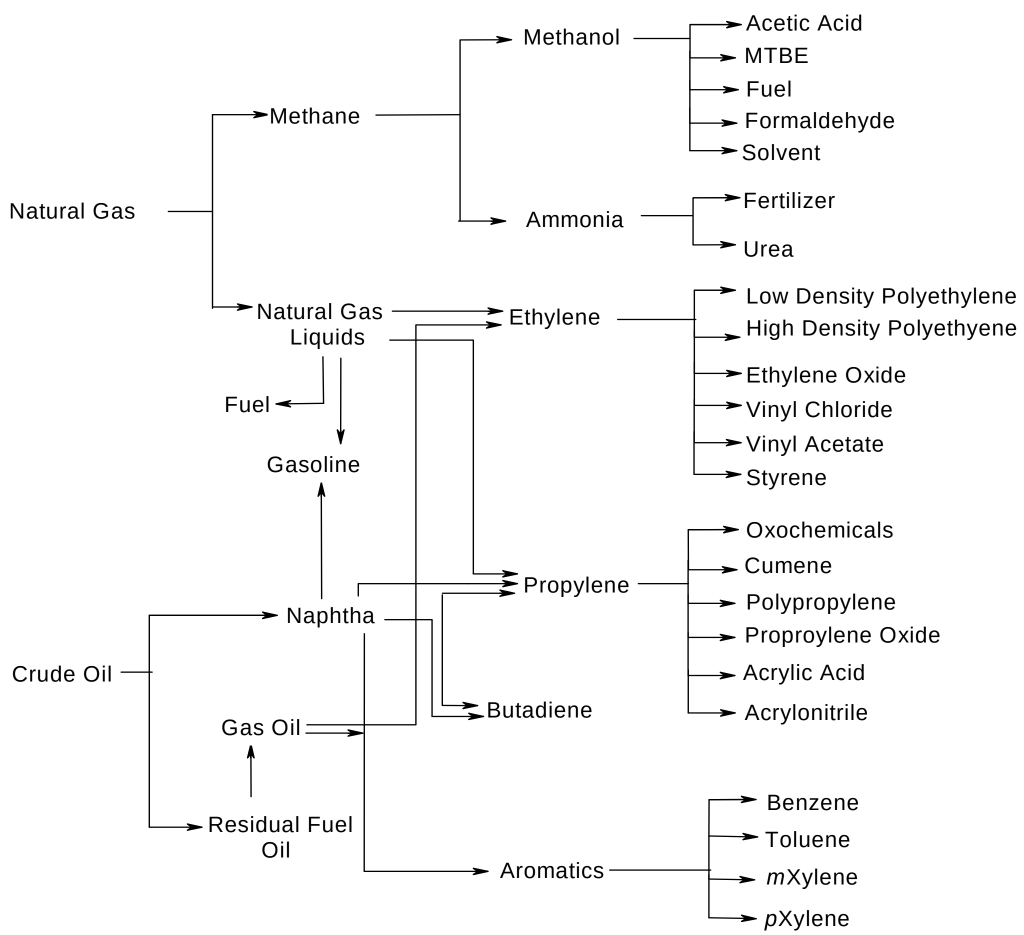


Figure 2: The Agrochemical Manufacturing Chain

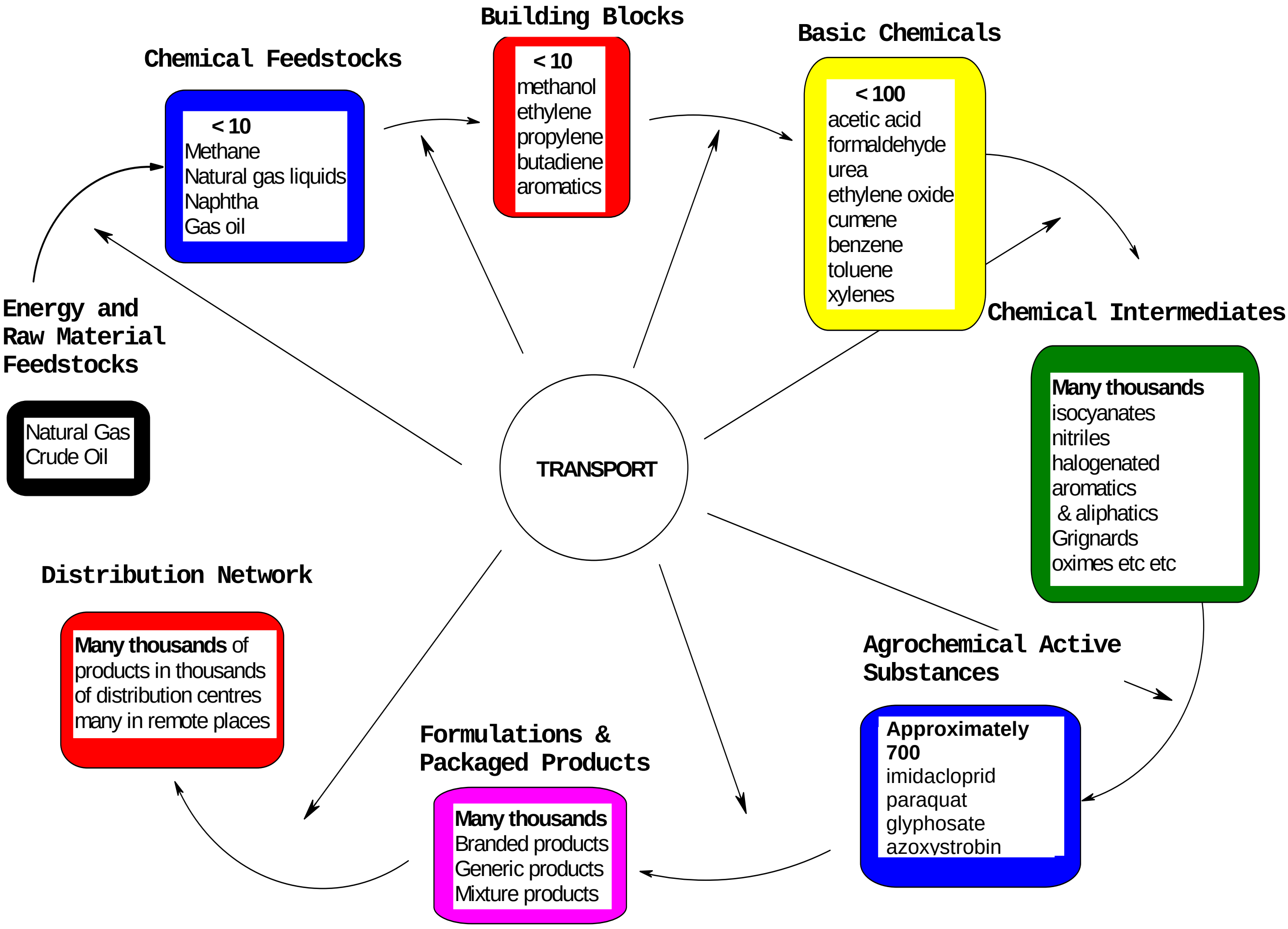
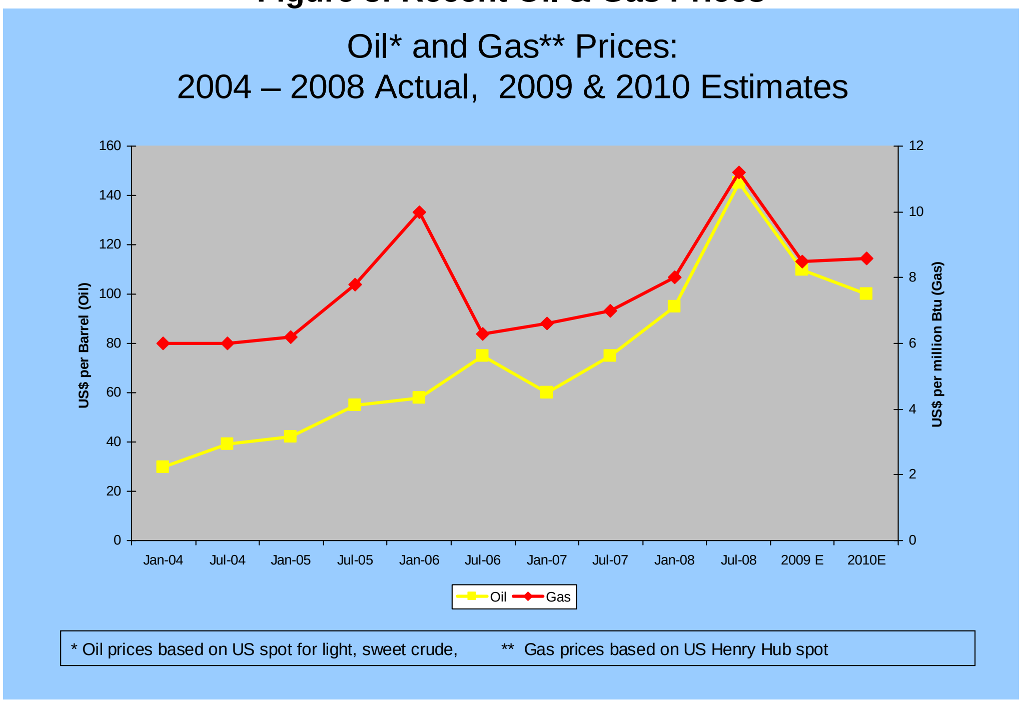


Figure 3: Recent Oil & Gas Prices



Raw Material Costs

Active substances and formulants comprise approximately 55% of agrochemical products' wholesaler prices. The main factors contributing to these costs are the raw materials, energy to manufacture, capital outlay and labour costs.

World oil and gas prices have nearly doubled over the past two years, as shown in Figure 3, reaching all time highs of US$150 per barrel and US$11 per million BTUs respectively. Also shown in Figure 3 are the expected oil and gas prices to 2010. Oil and Gas industry commentators believe that the current high prices will suffer a 'correction' but that the underlying price trends are upward.

The oil market is notoriously volatile, moving not only with more rational supply and demand factors but also with very unpredictable geopolitical, economic and weather-related factors. Short-term demand is being driven upward by growth in developing countries such as China, India and Brazil, however, it is being offset by lower demand in the largest per capita consuming country, using 25 barrels per year, the USA, where falling economic growth and high oil prices have lead to lower fuel requirements. The conflict between Russia and Georgia is just one of the current geopolitical factors influencing today's prices. For the longer-term, demand is expected to continue to grow strongly in developing countries, such as China where current per capita usage is less than 2 barrels per year. Longer-term supply is expected to become more restrained and expensive as deposits are increasingly difficult to find and extraction costs higher.

Prices of many basic chemicals widely used in the production of agrochemicals have risen dramatically over the last 2 years, for example ammonia (a basic constituent of chlorothalonil, mancozeb and picloram) up 75%, and sulphur (used alone as a fungicide and, for example, in mancozeb) up 500%. Agrochemicals' production has to compete with many other industries for raw materials and in times of high demand from other industries enjoying strong growth has had to pay the higher prices even though the agrochemical industry has not been able to pass on these higher prices.

As illustrated in Figure 2, production of agrochemicals not only relies on basic chemical building blocks but also on complex intermediates. Several intermediate producers of this class of compounds, including BASF, Kemira, Ciba and Dow, have recently announced price rises averaging some 20% citing their dependence on rising raw material, energy and transportation costs.

Energy Costs

Energy is essential at every stage of a production process and its cost accounts, on average, for 8% of the total cost of manufacturing a chemical. For some compounds, however, energy can be much more significant. For example, chlorine and sodium hydroxide are made simultaneously by the electrolysis of brine and the electricity costs account for some 45% of production costs. The chemicals industry globally has spent considerable effort on improving energy efficiency and has been successful to a certain extent, however, energy costs still contribute significantly to manufacturing costs. Energy sources are subject to taxation in almost all countries but these vary considerably as governments use this fiscal instrument to different degrees. In China, the government has imposed reduced export tax rebates on high energy consuming chemicals to encourage use of more efficient technologies, which has severely impacted phosphorus manufacture and subsequently also manufacture of glyphosate and other phosphorus-containing agrochemicals.

In addition, energy costs, in the form of fuel are a major component of distribution costs accounting on average for 3% of the price of wholesale agrochemicals. However, distribution costs are also frequently incurred in the manufacturing chain. The manufacture of methoxyfenozide (see Appendix 1) involves a nine step synthetic pathway from 2,6-dichlorotoluene and will be carried out at multiple manufacturing sites, the final active substance will probably be transported to formulation facilities in different parts of the world. Finished products are then transported onto wholesalers who supply farmers locally.

Overall, fuel costs are important and with some 96% of transportation costs relying on oil, the increased oil price will have a significant upward impact on agrochemical prices, especially in the final selling price to farmers.

Environmental Costs

For manufacturers of crop protection chemicals in developed countries, the regulatory environment covering emissions to air, water and other waste streams, such as landfill, is both stringent and strictly enforced. The EU and US have introduced several laws over the last 30 years which control the safe manufacture of chemicals in general and pesticides in particular from both the environmental and personal health and safety angles. This legislation has, in the opinion of some, put developed world manufacturers at a disadvantage to those not subject to the legislation from an economic point of view. However, process improvements have often resulted in more efficiency and the prevention of pollution at source is always more economically viable than cleaning up post problem events.

With about 20% of the world population and only 7% of world arable land, China has encouraged greater production of food and in doing so has become a major consumer and producer of pesticides, using some 1.2 million tons and making over 300 types of active substances. It also exports both active substances and formulated products widely. In recent years, the environmental pollution from poorly regulated manufacturing plants across all industries in China has become an increasingly serious, high profile issue. Although China has put in place a framework of legislation to promote cleaner production and better energy conservation as part of its move to a more market-oriented rather than a centrally controlled state, the laws are not yet taking full effect and enforcement is hampered by the low numbers of personnel at its Ministry of Environmental Protection. In preparation for the Olympics held in Beijing this summer, China took many measures, such as shutting down many chemicals' factories, delaying licenses for manufacturing capacity extension, and only allowing limited car traffic, that were designed to reduce the pollution, especially air 'smog'. These were perhaps short-lived improvements, but there are signs that China is moving to tackle its environmental issues, as evidenced by the measures taken after the Lake Taihu pollution incident in 2007, when the authorities closed down all the polluting factories around the lake and ordered them to meet new water emission standards. Legislative pressure, such as from the EU's REACH (Registration, Evaluation, Authorisation and restriction of Chemicals) legislation which came into effect in 2007, from countries to which China exports products are also helping to reduce pollution in China. It is thought that REACH will impact Chinese companies exporting pesticides to the EU by increasing production costs by some 6%. Together with higher energy costs, environmental costs are responsible for increased costs, estimated to be as much as 3X, across almost all chemicals in China.

It is interesting to note in respect of agrochemicals manufacture that two major manufacturers, Syngenta and BASF, have recently announced that they are to invest more in in-house manufacture, mostly in plants in Europe and the US. This represents a counter-trend to that seen over the last decade where manufacturing has been out-sourced, especially to developing world producers such as in China, and reflects the changing relative cost structures of the developed to the developing world. In future, it is likely there will be diminished cost benefit to sourcing from developing world producers as environmental standards become global.

Formulation and Packaging Costs

In addition to the global increase in active substance costs, oil and gas price rises have had a major impact on a number of other agrochemical product components, including surfactants (an important component of formulations), solvents, paper and plastics, and printing inks. As with active substances, not only do these impact raw material costs but also manufacturing costs.

Ethylene oxide is a key raw material for surfactants. It is produced by the catalytic oxidation of ethylene which in turn comes from oil or gas. Prices for ethylene have risen from around US$600 per ton in 2006 to US$1,000 per ton in 2008 due to higher raw material costs and demand outstripping supply. Ethylene prices are forecasted to level and even decline to around US$800 per ton over the next 3 years as more capacity comes on stream from new Middle Eastern producers so surfactants are not expected to significantly drive agrochemical prices upwards in this time frame.

Ethylene is also a key building block for packaging and polyethylene prices are currently at a 20 year high, thus contributing to higher agrochemicals' prices.

Pricing Agrochemicals

Pricing of crop protection products is, in line with most complex products of industrialisation, and despite the relatively high proportion of costs that the active substance is responsible for, not just a simple cost-based plus equation but linked with market-dependent forces of supply and demand. It is therefore not surprising that there is considerable variation in prices by country and that cost setting involves detailed analysis of the target consumers, i.e. the farmers, the value of products to them and the competing products.

However, raw materials and energy costs involved in manufacture are significant to the industry so the importance of recent price rises of oil and gas cannot be dismissed as a major factor in the increases of crop protection products. Several major manufacturing and marketing companies of agrochemicals, including Syngenta, Dow and Bayer, are already on record recently as flagging up potential price hikes due to raw material costs.

For the major global crop protection companies that are active globally, the relative strength of currencies is also an important factor, and the weak US$ is likely to further pressurise prices from US-based companies. High demand and rising basic costs in a market which is experiencing higher selling prices, i.e. a generally inflationary market, offers agrochemicals' manufacturers the opportunity to pass on cost increases and improve margins.

Glyphosate – an in-depth look

Glyphosate, a non-selective herbicide, is the largest agrochemical in the world with total sales estimated to be almost US$5bn in 2007, accounting for around 14% of all crop protection sales and some 6X greater than the second largest product, the insecticide, imidacloprid.

Launched in 1974 by Monsanto as Roundup, glyphosate is now off-patent and has several manufacturers and suppliers worldwide. Over the past decade, the adoption of Roundup tolerant crops, notably corn and soybean in addition to its high cost efficiency, versatility with respect to when it can be applied and its use in no-tillage practices to reduce fuel costs, have driven glyphosate use.

Prices for glyphosate have risen considerably over the past two years with branded Roundup prices in the US now standing at about US$18 per gallon compared to US$13 /gal in 2006. The branded price increases have been lower in percentage terms than generic products which have seen price increases of between 60% in India through 100% in Australia, 300% in Brazil and Argentina and as much as 400% in China. Price increases have mainly been caused by the high demand and a scarcity of supply from generics producers. This scarcity of product has been caused by soaring raw material prices, especially yellow phosphorus, and energy costs.

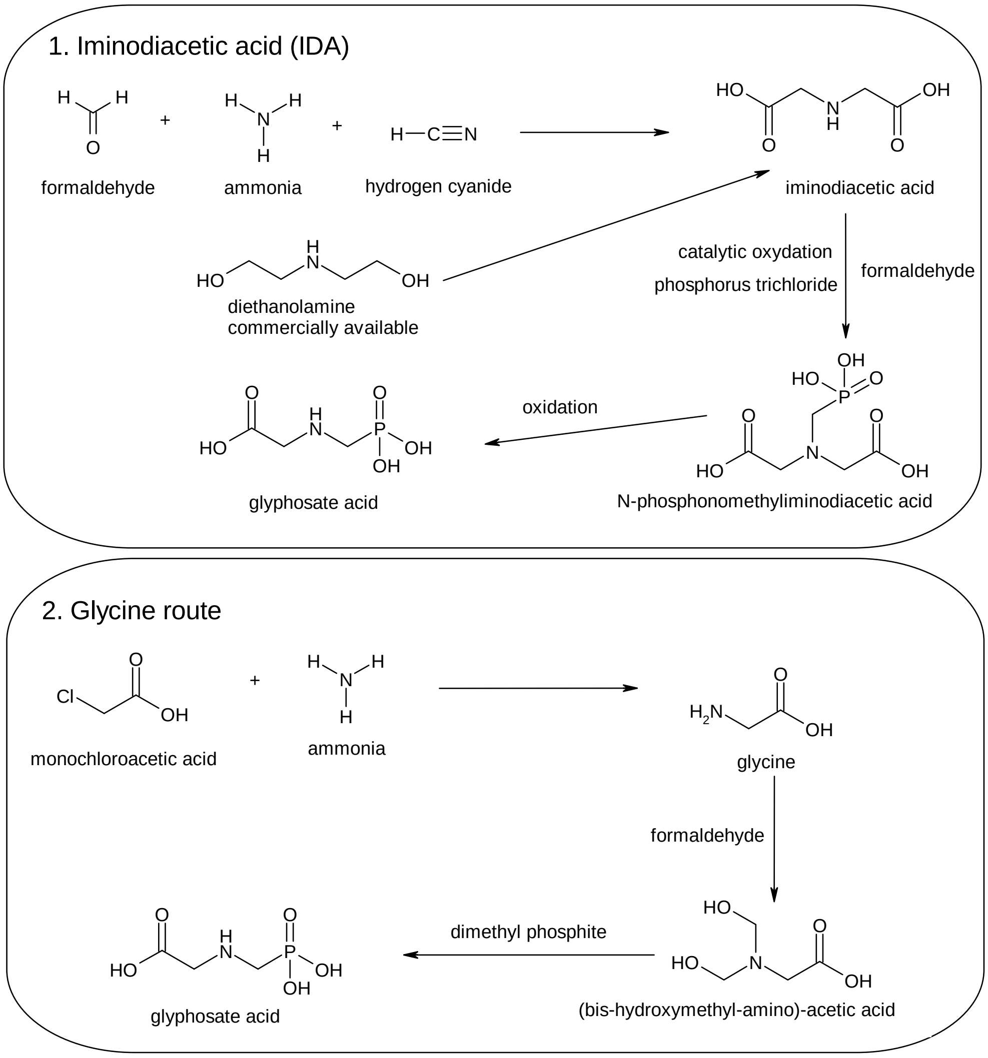
There are two main commercial routes by which glyphosate is synthesised – see Figure 4. Both routes require phosphorus reagents which are derived from elemental yellow phosphorus which in turn is made from phosphate rock by thermal reduction which requires huge energy input (14,000 kWh of power to produce 1 ton, accounting for 60% of production costs). About 6% of global phosphate rock is used to make elemental phosphorus with about half of this being used in the manufacture of glyphosate and other phosphorus-containing pesticides such as chlorpyrifos, malathion and terbufos.

By the end of 2006, China had become the largest producer of yellow phosphorus but its myriad of inefficient plants were using so much energy and producing so much pollution that, when faced with shortages of hydroelectric power, the authorities began to restrict production resulting in closure of plants and higher prices. Many generic producers of glyphosate relied on Chinese phosphorus and have had difficulty in securing supplies resulting in low glyphosate availability and high prices.

Phosphate rock is also used to produce phosphate fertiliser, notably diammonium phosphate (DAP), in a 'wet' process using sulphuric acid. Because DAP demand is so great worldwide at present, prices of phosphate rock have soared by around 600% from Jan 2007 to Jul 2008, and the lower grade ores used to make elemental phosphorus are now being diverted to make fertiliser, thus adding to the high raw materials prices for glyphosate.

Monsanto owns phosphate rock mines in Idaho and due to this integrated position has been better placed to supply globally at a time of shortages resulting in a shift of market share to its brands in several markets, such as Brazil, Argentina and the US. If shortages of Chinese phosphorus continue, glyphosate prices is likely to rise further, however, high prices for glyphosate and glyphosate resistance becoming more widespread will encourage higher use of other herbicides such as Syngenta's Callisto (mesotrione) and/or combinations of less expensive products, such as 2,4D with glyphosate.

Figure 4: Glyphosate Synthetic Pathways



Summary

There are four key themes emerging from this review of current agrochemicals pricing:

1. Agrochemicals are directly linked to crude oil and natural gas prices as these are the main components of the raw materials required to manufacture them. In addition, energy costs for manufacture are also linked to crude oil prices. Therefore, it is inevitable that increases in oil and gas prices will transfer through to higher agrochemicals prices, unless manufacturers of agrochemicals can absorb their costs increases, or there is excess supply.

2. Transport and energy costs are also linked directly to crude oil prices and so any further increases are likely to raise agrochemicals prices. Additionally, because many countries have significant taxation of fuel, energy efficiency considerations may add extra costs to the distribution chain.

3. The current buoyant market of increasing farm incomes and high demand for food and hence for crop protection products combined with constraints to supply, especially of high quality products, offer favourable conditions for price increases from manufacturers.

4. The cost of the energy component of the manufacture of agrochemicals varies considerably from product to product and is dependent on inter alia the number of steps and the type of processes involved. In general, older products are simpler to manufacture and require fewer manufacturing steps and hence lower energy requirements compared to newer products. However, older products need a much higher application rate to achieve the desired effect compared with newer products.

Appendix

Comparing Old & New Chemistries for Selected Agrochemicals

Over the last 60 years the science involved and the knowledge base in the development of new pesticides has become more and more sophisticated. New active substances now are complex organic chemicals compared to older products.

The cost of the energy component of the manufacture of agrochemicals varies considerably from product to product and is dependent on *inter alia* the number of steps and the type of processes involved. In general, older products are simpler to manufacture and require fewer manufacturing steps and hence lower energy requirements compared to newer products. However, older products need a much higher application rate to achieve the desired effect compared with newer products. Thus, it is very difficult to generalise about whether older products are more or less energy dependent than newer products and only individual case studies will determine true comparisons.

In order to gain an acceptable return on the investment made by R&D based companies they strive to substitute older generic products with new patented protected products. The uptake of new patent protected products tends to vary from region to region. Traditionally, Europe, USA and Japan have been quicker to adopt new products whereas Africa, Asia and S. America have been slower and as a result have a higher market share taken by older generic products.

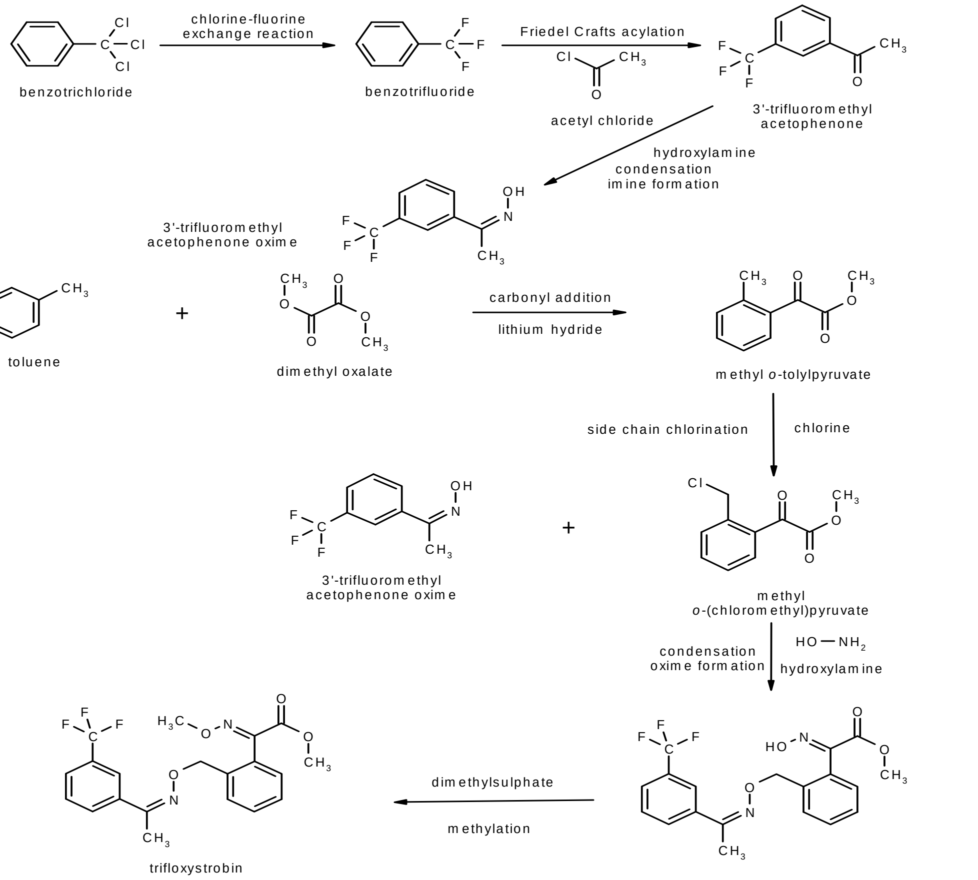
Table 1 lists typical older (generic) and newer chemistries used, for example, in South American markets. The synthetic pathways for a number of these products are also presented to show the comparative complexity of the two types of products.

Table 1: Examples of older and newer type products used in S. America

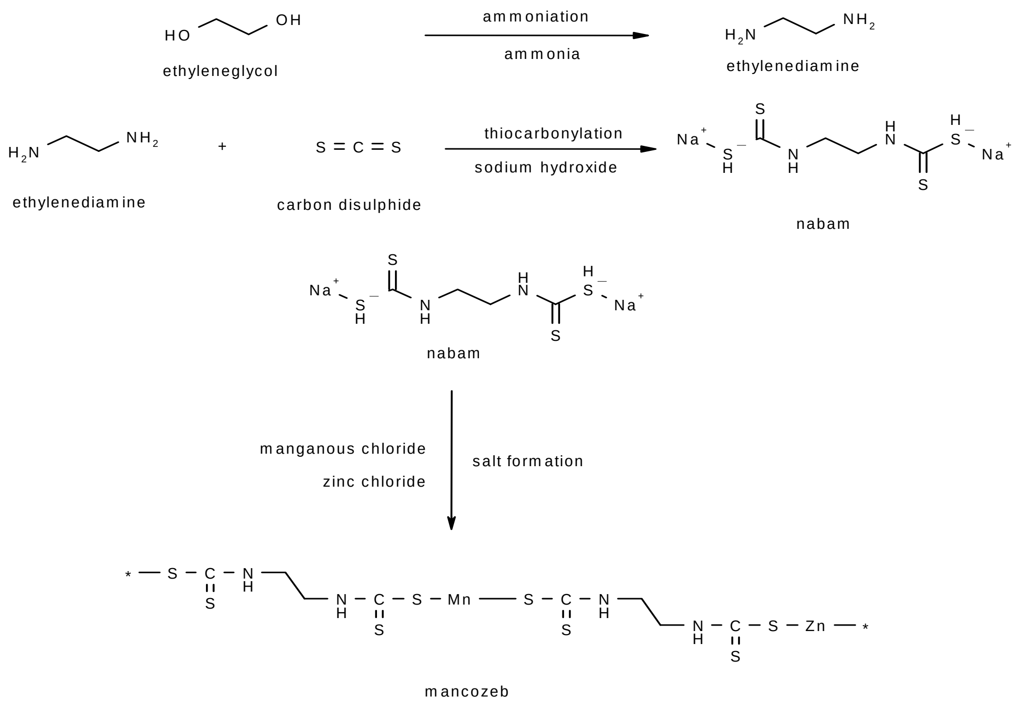
Generic Products	Newer Patent Protected Products
Mancozeb	Trifloxystrobin
Glyphosate	Mesotrione
Paraquat	Metaflumizone
2,4-D	Methoxyfenozide
Picloram	Thiamethoxam
Chlorpyrifos	Spiroxamine
Chlorothalonil	
Carbofuran	
Cymoxanil	
Carbendazim	
Triazoles	

Comparison of old chemistry (mancozeb) and new chemistry (trifloxystrobin)

1. Synthesis of trifloxystrobin

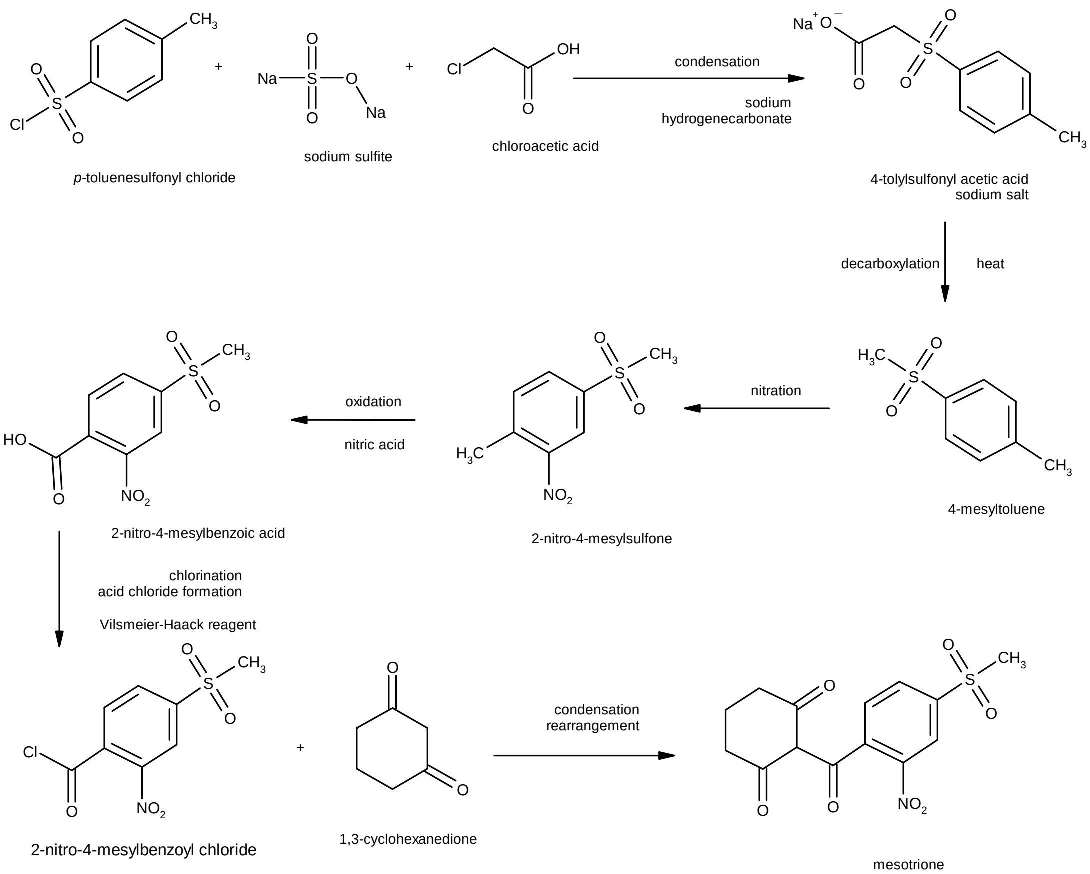


2. Synthesis of mancozeb

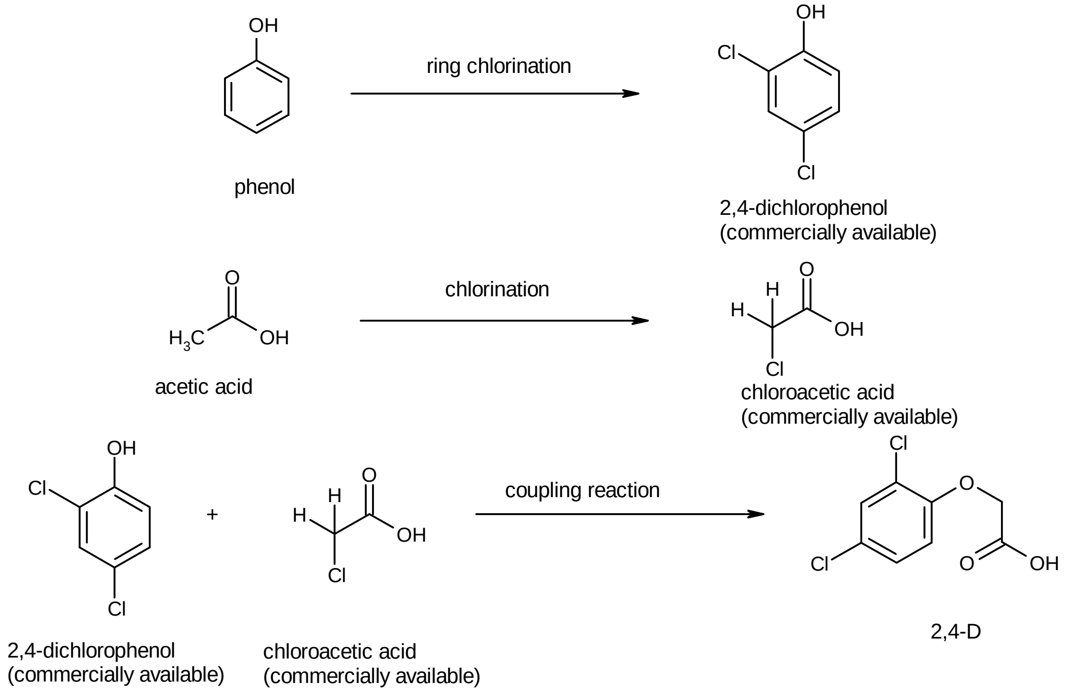


Comaprison of old chemistry (2,4-D) and new chemsitry (mesotrione)

1. Synthesis of mesotrione

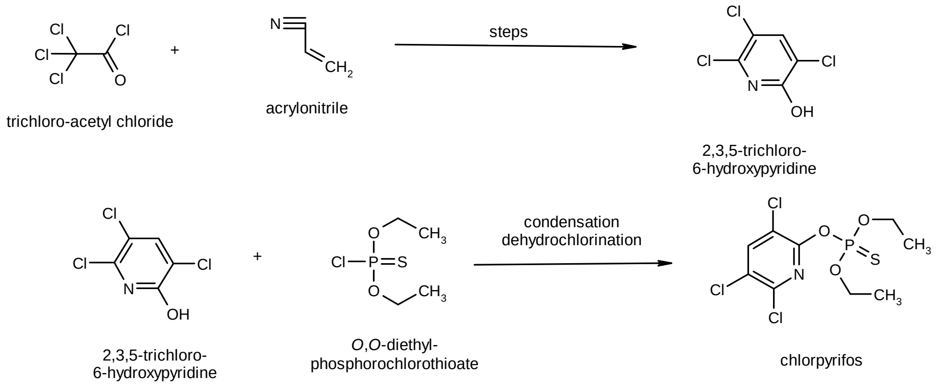


2. Synthesis of 2,4-D



Comparison of old chemistry (chlorpyrifos) and new chemistry (methoxyfenozide)

1. Synthesis of chlorpyrifos



2. Synthesis of methoxyfenozode