

The perils of paraquat

Sales targeted at developing countries

Paraquat is amongst the most widely used pesticides for weed control. Its adverse health effects are recognised, and industrialised countries that allow paraquat use all recommend stringent precautions. But these conditions cannot be guaranteed in developing countries. The leading manufacturer, Syngenta, now shares the market with other companies, and all target sales in Asia and Latin America, where public interest groups have called for a phase out because of health concerns. Barbara Dinham reports.

In the South African fruit farming industry a common practice involves applying weed killers from a hand-held hose behind a moving tractor. The herbicide, often paraquat, drips from puncture holes in the hose. The work is regarded as suitable for temporary labour, frequently women workers, who wear little or no protective clothing¹. Paraquat is used in dozens of different cropping systems. As much as 70% may be used in developing countries. In 2002, a group of five public interest organisations called for a phase out of the promotion and sale of paraquat products in those countries². The groups spanned three continents: Berne Declaration of Switzerland, Swedish Society for Nature Conservation, Foro

Emaús of Costa Rica, Pan Asia and the Pacific (PANAP), and PAN UK.

The tarnished reputation of paraquat stems from its acute oral toxicity and associated ill-health for users, particularly in the plantation sectors. Some of these effects include headaches, skin rashes and ulceration, nausea, nosebleeds, loss of finger and toenails, and eye irritation. While most injuries are external, ingestion of one teaspoon is fatal. There is no antidote, and death generally follows within three weeks (see box 1).

The largest manufacturer, now the Swiss company Syngenta, acknowledges problems with skin irritation and nail damage³. It indicates that these 'may be found

during occupational exposure, mainly in hand-held applications, as a result of unwashed spillages, from unwashed splashes of commercial product, or from prolonged dermal contact with spray solution,' and adds that the damage is 'indicative of inadequate standards of personal hygiene.' But studies indicate the difficulties facing workers, and even small-scale farmers, in reaching required levels of hygiene⁴. The company view that 'occupational incidents can occur when the instructions for use are not followed' is the nub of the problem. The major markets for paraquat are in Asia, Central and South America (see box 2), where on average 70% of people earn a living from agriculture, and these are overwhelmingly the poorest. Can these small-scale farmers and agricultural labourers use products like paraquat in field conditions without harm to their health?

Formulation changes

When first marketed, the dark brown colour led to paraquat products being mistaken for drinks like coffee or cola, particularly when decanted to other containers – a common practice in developing countries. It was also used widely to commit suicide. Despite this risk, the World Health Organisation classifies paraquat as 'moderately hazardous'.

Since the late 1970s, the main manufacturer has added various safening agents to formulations – a colour, smell (or stench – a strong and deterring odour) and emetic (to induce vomiting). Subsequently the UN Food and Agriculture Organisation (FAO) developed a specification for active ingredient concentrates, requiring an effective emetic and blue/green colorants and encouraging the addition of other safeners including stenching agents and thickeners. Paraquat is no longer under the exclusive patent of Syngenta. It is not known whether all manufacturers follow the FAO paraquat specifications in all their product lines.

Precautions and restrictions

Industrialised countries

A number of governments in industrialised countries, primarily concerned with health risks, have banned paraquat. Within the European Union (EU) it is banned in Austria, Denmark, Finland and Sweden; the EU is currently deciding whether to re-register it (see below); Hungary, Slovenia and Switzerland have also banned it.

Syngenta indicates that paraquat is registered in over 120 countries, for use on many crops (see box 3). But the registrations often include precautionary risk mitigation measures. Under the current EU risk classification and labelling⁵, paraquat warnings state it is very toxic by inhalation, toxic in contact with skin and if swallowed, irritating to eyes, respiratory system and skin, and can be a serious damage to health. When the US Environment Protection Agency (US EPA) re-registered paraquat in 1997, it found that the margin of exposure

Box 1. Health effects of paraquat

A paper published in 2001 analysed the health effects of paraquat in developing countries, drawing on research published in a large number of peer-reviewed journals⁵. The studies showed that dermal exposure was the most likely route of uptake. While paraquat is poorly absorbed through intact skin, penetration is increased by damage to the skin. Scratches and broken skin are common in physical agricultural work, and paraquat itself is a skin irritant. Inhalation is not considered a high risk, but could not be excluded under some application methods. Accidental oral exposure can occur through splashes in the mouth during mixing, eating with contaminated hands, blowing or sucking blocked spray nozzles, or eating contaminated food. It may occur from swallowing 'run off' on the face caused by droplets in spray mist. Among the effects documented were:

- skin problems ranging from mild irritation, burns, ulceration, peeling, necrosis (cell death in skin tissue), dermatitis of the hand and blistering on hands, thighs, legs, back and scrotum

- eye injuries including blepharitis (eyelid inflammation), conjunctivitis, ulceration or keratitis (growth like a wart) of the cornea

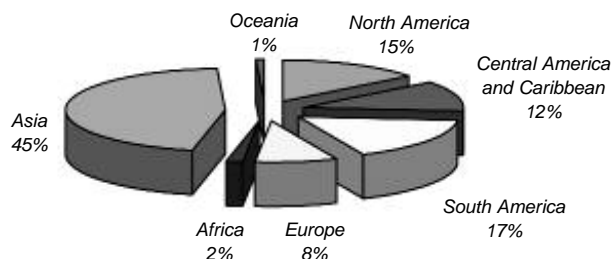
- severe exposure on hands can lead to nail damage, ranging from localised discoloration to temporary nail loss

- nosebleeds resulting from local irritation of the upper respiratory tract, burning sensation in the nose

- systemic paraquat poisoning is characterized by burns of the upper digestive tract; and multi-organ failure, including the lungs, liver, and kidneys and less frequently the central nervous system, heart, suprarenal glands and muscles. In fatal cases death is due to respiratory failure from pulmonary oedema or pulmonary fibrosis up to over a month after the event. While fatalities are generally suicide cases, one study identified 15 unintentional fatal poisonings, including five due to contact with diluted spray solution⁶

- some chronic effects have been identified: a weak association with developmental and reproductive effects, and a link to Parkinson's disease.

Box 2. Paraquat use per region⁷



for handlers using a backpack sprayer – the most common form of application in developing countries – had been too low⁹. Products are classified for restricted use (purchase and use only by certified applicators). Workers who mix and load paraquat are required to supplement their use of Personal Protective Equipment (PPE) by wearing gloves, a chemical-resistant apron and face shield. PPE requirements for those applying paraquat include a long-sleeved shirt and long pants, chemical-resistant gloves, shoes and socks. A minimum 12-hour re-entry interval should be observed, increasing to 24 hours when used to defoliate crops such as cotton or potatoes before harvest.

The German registration authority asserted in 1983 that repeated treatments of paraquat led to accumulation in the soil and damage to crops. ICI (the original producer, and a fore-runner of Syngenta) took legal action. Although the German authority lost the court case, it now allows only a 10% formulation rather than the previous 20% and permits field crop applications no more than once every four years – and only in areas at risk from erosion. Wider registrations were refused because of effects on the environment¹⁰.

Switzerland banned paraquat in 1989. Ironically, following the spate of agrochemical company mergers, paraquat is now banned in the home country of the main producer. The Swiss government has indicated that it will review its risk evaluation and notify its control action to the secretariat of the Rotterdam Convention on Prior Informed Consent (PIC) for Certain Hazardous Chemicals in International Trade¹¹. When two notifications of a ban, based on a risk evaluation, have been received under PIC, the chemical is considered for inclusion on a PIC List, giving governments the opportunity to decide whether they allow or prohibit its import.

Paraquat registration in Europe¹²

The EU is currently considering whether to re-register paraquat (under the Registration Directive 91/414/EEC). The registration decision has twice been deferred, having been contested by some Member States, and its next meeting is scheduled for 26 June 2003.¹³

Sweden is very concerned that registration would force the product onto its mar-

ket. The Swedish position is that:

‘Inclusion of paraquat in Annex I of Directive 91/414/EEC is in our view not in line with the precautionary principle. Paraquat is an extremely hazardous substance, which may cause severe and irreversible injuries in humans. Exposure model calculations, as well as field studies, indicate an unacceptably low margin

of safety. Due to paraquat’s characteristic toxicity, accidents might result in fatal injuries, which cannot be counteracted by any known antidote. In addition, we also feel that there is a global responsibility we have to take into consideration resulting from the use in developing countries and the contradictory signals an inclusion of this substance might give rise to. Consequently, Sweden cannot support an inclusion of paraquat into Annex I of

Directive 91/414/EEC.’

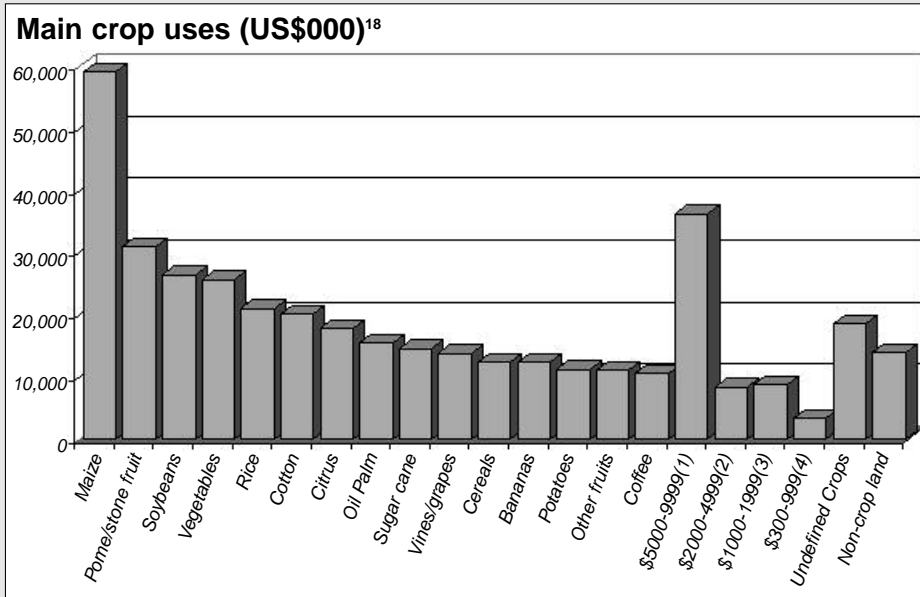
The Standing Committee on the Food Chain and Animal Health makes recommendations to Member States on placing products on the market. The Committee noted concerns about pulmonary lesions observed in animals, and effects on eyes, but concluded that: ‘Based on the field exposure studies ... when paraquat is used as a plant protection product (pesticide) as recommended under prescribed good working practices, its use does not pose any significant health risk for the operators.’¹⁴

On environmental concerns, the Committee confirmed there are situations where ground nesting birds may be exposed, but concluded that ‘there are several situations where exposure ... will be negligible and hence the risk acceptable.’ They confirmed that paraquat can cause lethal and sub-lethal effects on hares.

The recommendation being put forward by the Committee is that paraquat risks would be acceptable if appropriate risk mitigation measures are applied. While they may be amended, the current recommended

Box 3. The product, its uses and main crop markets

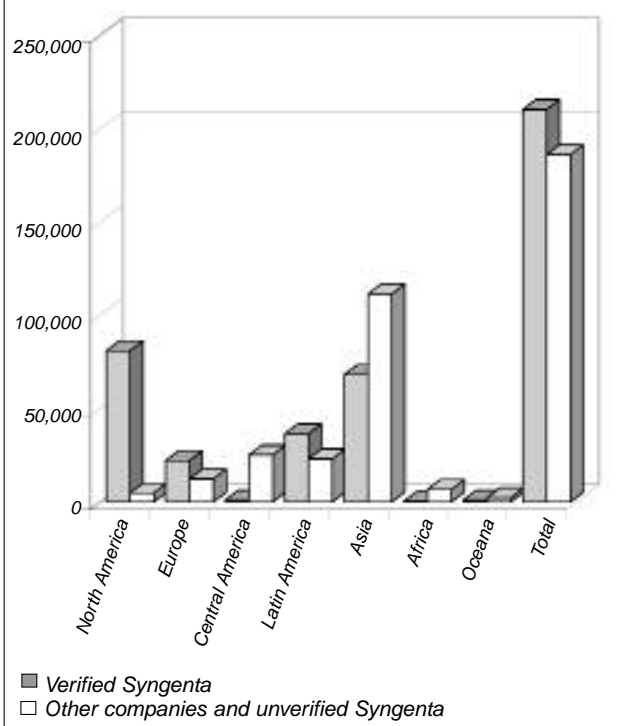
Paraquat is a non-selective herbicide, first marketed in 1962 under the trade name Gramoxone by ICI agrochemicals. It is a contact herbicide and kills annual broad-leaved weeds and grasses, and certain perennial weeds, by stopping the energy producing cells and rapidly desiccating (drying out) the tissue¹⁶. It does not harm mature bark, and is thus widely used for weed control in fruit orchards and plantation crops. It is used for weed control on non-crop land and can be used as a defoliant on certain crops before harvesting, and a desiccant to speed up the removal of dead matter. Paraquat is increasingly used to destroy weeds in preparing land for planting in combination with no-till, or conservation-till, agricultural practices, which minimise ploughing and help prevent soil erosion. Brazil, for example, has 11 million hectares under conservation tillage, much of it using paraquat, as well as half the soybean area, nearly half the maize and large areas of wheat, rice and cotton¹⁷. The main crop use for paraquat is in association with maize, followed by orchards, soybeans, vegetables and rice.



Notes below represent the combined sales of the following crops (each with annual sales at a figure between the values indicated):

- (1) Tea, rubber, cassava, tree nuts, olives
- (2) Forage crops, peas, beans, small grains, industrial markets
- (3) Oilseed rape, cocoa, groundnuts, sunflower, tobacco, other oilseeds
- (4) Tomatoes, forestry, coconuts, flowers, beets, spices

Box 4. Market shares of paraquat (US\$000)²³



requirements include:

- technical active ingredient must comply with the FAO production specifications
- particular attention is required to the protection of operators, in particular for knapsack and hand-held applications
- products should be available only to *bona fide* agriculturalists, horticulturalists and professional users
- consideration should be given to limiting knapsack and hand-held use to trained and certified personnel where appropriate training and certification schemes are in operation
- spray concentration must not exceed 2g/litre for knapsack and hand-held applications
- where potential for exposure of eggs of ground nesting birds exists, use of paraquat may only be authorised when appropriate risk assessment has demonstrated that there is no unacceptable impact
- risk assessment must demonstrate no unacceptable impact on hares

Developing countries – Malaysian phase out

A number of developing countries have banned or severely restricted paraquat, including Indonesia and Kuwait, but the most significant development has been the decision by the Malaysian Pest Control Division to phase out all uses. Malaysian plantation workers have struggled for almost 17 years to encourage their government to ban paraquat. On 27 August 2002, the Pesticide Control Division of the Agriculture Department issued a circular,

endorsed by the Secretary of the Pesticide Control Board, stating that all new applications to register or re-register paraquat would be rejected with immediate effect. The last registration for paraquat in the country expires in 2005. All currently registered products would be phased out in stages, and industry has not been asked to recall stocks. Advertising of paraquat products must cease. In effect the registration authority has carried out a comparative assessment (see page 20) of the risks of various products, and concluded that less risky alternatives are readily available on the market¹⁵. Industry, however, would like to see the ban overturned.

The control action was taken by the Pesticide Control Division of the Ministry of Agriculture, and endorsed by the Secretary of Malaysia's Pesticide Control Board. Companies producing paraquat have been lobbying the government to change its decision, and some local papers have been calling for a repeal. In October 2002, Pesticide Action Network Asia and the Pacific (PANAP) launched a campaign to ensure the phase out of paraquat in Malaysia is maintained. (see box 5).

Paraquat – the producers

Paraquat no longer has patent protection. Syngenta remains the major producer, with its products accounting for at least 50% of the market (see box 4). Syngenta was formed in November 2000 by the merger of the Swiss Novartis and the UK-Swedish company AstraZeneca, itself a recent merger. The international headquarters is in Switzerland. Its geographical history led to a listing on four stock exchanges: Switzerland, New York, London and Stockholm. Syngenta is the largest of the six major agrochemical companies. Its agrochemical sales in 2002 amounted to US\$5,260 million and sales of seeds came to US\$937 million.

In Europe, another 11 companies have requested registration of paraquat: Barclay Chemicals (Ireland), BV Luxan (Netherlands), Calliope SA (France), Grower (Greece), Helm AG, Hamburg (Germany), Marubeni (UK),

United Phosphorus (India), and four Spanish companies: Industrias Afrasa, Agrolac SA, Aporta SA – Barcelona, and Pilar Iberica SA¹⁹. Other basic producers in Argentina, Taiwan and the US make paraquat.

The proliferation of producers does not give the full picture of the importance of the product to Syngenta, as the company is also an important producer of raw bipyridyl and may supply the technical product to other companies. It has production plants in Huddersfield UK, Bayport Texas, and 50% ownership of a plant in Japan²⁰. In April 2001 the long-planned US\$85 million plant in Nantong, China, came on stream. The plant, a joint venture with Jiangshan Agrochemical and Chemical Co and Nantong Petrochemicals Corporation, has a capacity of 6000 tonnes and will supply China and other Asia Pacific countries²¹. In March 2001, Syngenta announced the closure of its paraquat plant in India. Syngenta has a number of formulation plants for paraquat, and minority interests in some of the other producers, for example the Malaysian producer²².

The major markets

Herbicides have the largest share of all agrochemical categories, with sales of US\$13 billion in 2001, representing 47% of the overall pesticide market. By far the largest selling non-selective herbicide is glyphosate, sold by rival Monsanto under the trade name Round-up. However paraquat maintains a significant share of the market. The US is the biggest single market for paraquat, but Asia is the most important region (see tables 1 and 2), followed by South America. In both regions it is used extensively in plantations, and by many small scale farmers – for example around one million farmers in Malaysia use

Table 1. Top 12 markets for paraquat³⁰

Country	Sales US\$000	Year	Confirmed % Syngenta sales
United States	56,866	2000	99
South Korea	44,308	2000	n.a.
Brazil	34,586	2000	100
China	34,269	2000	96
Thailand	28,471	2001	64
Mexico	28,192	2000	85
Japan	24,768	2000	n.a.
Malaysia	20,944	2000	n.a.
Colombia	14,725	2000	n.a.
Spain	9,903	2001	3
India	9,419	2001	93
Guatemala	8,464	1999	n.a.
Total	314,915		

Table 2. Regional distribution of paraquat sales in the 46 top markets (US\$000)³¹

	Total sales
Asia	179,571
Central and South America	85,842
North America	85,784
Europe	34,648
Africa	7,085
Oceania	3,255
Total	396,185

*Sales figures from the latest year available in each country, range is 1995:2001.

paraquat²⁴.

An industry report²⁵ estimates that global sales of paraquat are over \$1,000 million annually at end-user level, equivalent to about 25,000 tonnes. In 2001, Syngenta reported sales of its three non-selective herbicides (paraquat, diquat and glyphosate trimesium) of \$687 million – and the company predicts continued ‘good sales’ of paraquat²⁶. Most companies had pinned hopes of a growing market for agrochemicals on the Latin American region, but growth slowed towards the end of the 1990s²⁷. In Latin America, Syngenta’s strategy is to target the large Brazilian and Argentinean markets. Industry observers indicate that the targeting of larger, more financially stable farmers in Brazil, and offering complete service packages, has proved successful: ‘Syngenta has managed to ... generate more revenue per farmer and take market share.’²⁸ The company’s 2002 annual report points out that, ‘New marketing programs for Gramoxone in Australia and China increased sales. Two years after the opening of the Nantong plant, China has become the second largest market for Gramoxone after the US.’²⁹ The huge Chinese market is obviously important to the company, reflected in the switch of production to China from India.

Removing paraquat from the market

There is widespread agreement, supported by the main manufacturers, that when applying paraquat it is essential to ensure that precautions are in place and are strictly followed. Yet many manufacturers of paraquat, including Syngenta, are targeting sales at poorer parts of the world, including China, and other Asian and South American countries.

Removing paraquat from developing country markets poses a significant challenge, but the level of concern about its use in poor regions underlines the importance of finding alternatives. In some crops and areas, important advances have been made. The International Policy of the Forest Stewardship Council, revised and approved

in July 2002, prohibits the use of paraquat to all certified members³². Paraquat is not allowed on products certified by the Rainforest Alliance. As a result Chiquita has ceased using paraquat on its plantations. The Fairtrade Labelling Organisation prohibits the use of paraquat.

A number of Swiss retailers have decided to eliminate products on which paraquat has been used in production. Since 1 January 2003 the second largest Swiss retailer, Coop, sells only bananas produced without paraquat. The Coop is working with Dole, its main banana supplier, to reduce the use of herbicides in production and puts a special emphasis on ‘fairtrade’ bananas, which are produced without herbicides. Its aim is to supply all ‘fairtrade’ bananas (one third of total sales) exclusively from organic sources. The Coop is also working to reduce herbicide use in other tropical products. The largest Swiss retailer Migros has indicated that it only sells products containing palm oil produced without the use of paraquat. One of the world’s largest coffee traders, the Swiss company Volcafé, has banned paraquat from all its own plantations³³.

Initiatives from retailers and trading organisations have demonstrated that successful alternative production strategies are available. The public interest groups calling for a phase-out of paraquat production believe that Syngenta should take the lead in halting production and sales in developing countries³⁴. The European Commission should take the lead in removing the product from the European market and helping developing countries to find safer alternatives.

Box 5. Support Malaysian paraquat ban

Letters in support of the phase out can be sent to the Pesticide Board, the Prime Minister and other government Ministers. For additional background information contact the Paraquat Campaign on the PAN Asia Pacific website panap@panap.net A model fax to the Agriculture Minister in support of the Malaysian ban is available on the Berne Declaration website www.evb.ch/stopparaquat_en.htm (please send a copy to PAN Asia Pacific)

References

1. London L, Rother H-A, *Failing Laws, Assumptions and Realities for Women in South African Agriculture*, in Jacobs M and Dinham B (eds), *Silent invaders: pesticides, livelihoods and women’s health*, Zed Books, London, 2003, p207.
2. Madeley J, *Paraquat – Syngenta’s controversial herbicide*, Berne Declaration, Zurich, PAN UK, London, Swedish Society for Nature Conservation, Stockholm, PAN Asia and the Pacific, Penang, Foro Emaús, Costa Rica, April 2002.
3. Summary rebuttal to the report entitled ‘Paraquat – Syngenta’s controversial herbicide’, www.syngenta.com
4. Wesseling C, Van Wendel de Joode B, Ruepert C, León C, Monge P, Hermosillo H, Partanen T, *Paraquat in Developing Countries*, *International Journal of Occupational and Environmental Health* October/December 2001, 7:275-286.
5. *Ibid.*
6. Wesseling C, Hogstedt C, Picado A, Johansson L, *Non-intentional fatal paraquat poisonings among agricultural workers in Costa Rica: a report of fifteen cases*, *American Journal of Industrial Medicine*, 1997, 32:433-41.
7. Industry sources, data covering the period 1995-2001.
8. Council Directive 67/548/EEC on the approximation of laws, regulations and administrative provisions relating to the classification, packaging and labelling of dangerous substances.
9. United States Environmental Protection Agency, R.E.D. FACTS Paraquat Dichloride, Prevention, Pesticides And Toxic Substances (7508W), EPA-738-F-96-018, August 1997.
10. German paraquat decision endorsed but ICI to gain new registration, *Agrow*, No 166, 28 August 1992, p1 and *Agrow* No 175, 8 January 1993, p9.
11. Swiss Federal Council, answer to question No. 02.3477 ‘Ban on paraquat’ raised by Member of Parliament Josef Zisnyadis, 20 November 2002, http://www.parlament.ch/afs/toc/d/gesch/d_mainFra meSet.htm
12. European Commission, Review report for the active substance paraquat, Commission working document, SANCO/10382/2002, rev. 45, 21 February 2003, p3.
13. Pers. comm., Peter Bergkvist, National Chemicals Inspectorate, Sweden, 13 May 2003.
14. Directorate General Health and Consumer Protection, European Commission, SCP/PARAQ/002-Final, 16 January 2002, pp6-7.
15. Malaysian paraquat phase-out shocks industry, *Agrow*, 410, 11 October 2002.
16. Gramoxone® The herbicide with unique advantages, www.syngenta.com
17. Goulston G, *The agrochemical market in Latin America: market analysis*, *Agrow Report*, PJB Publications Ltd, UK, November 2002.
18. Industry sources, data covering the period 1995-2001.
19. European Commission, Review report for the active substance paraquat, Commission working document, SANCO/10382/2002, rev. 45, 21 February 2003.
20. Paraquat, *Pesticides News*, June 1996, 32:20-21.
21. Dewar A, *Agrow’s top 20: 2003 Edition*, *Agrow Reports*, PJB Publications, UK, July 2002, p448.
22. Paraquat, *op cit* 20.
23. Industry sources, data covering the period 1995-2001.
24. *Agrow*, *op. cit.* 15.
25. Copping LG, *Post-Emergent herbicides*, *Agrow Reports*, PJB Publications, UK, July 2002, p42.
26. Syngenta Group, *Financial Report 2002*, www.syngenta.com
27. Goulston G, *op cit* 17.
28. Deutsche Bank AG, Syngenta, *Feedback from Syngenta’s R&D day*, 15 May 2002.
29. Syngenta Group, *Annual Report 2002*, www.syngenta.com
30. Industry sources, data covering the period 1995-2001.
31. *Ibid.*
32. Forest Stewardship Council, *Chemical Pesticides in Certified Forests*, FSC-IP-0001, July 2002, www.fscoax.org/principal.htm.
33. Pers. comm., Coop and Dole Switzerland to Bernard Herold, Berne Declaration, 12 May 2003.
34. Madeley J, *op. cit.* 2.