

MEASURES AND ACTIVITIES THAT ASSIST WITH THE PHASE OUT OF METHYL BROMIDE

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ABSTRACT

By the end of 2001, about 135 countries had ratified at the national level the methyl bromide (MB) phase-out commitments of the Montreal Protocol. Countries typically regulate the consumption (national supply) of MB by limiting the quantity of MB that can be imported. During the phase-out of other ozone depleting substances (ODS) such regulations were often augmented by non-regulatory activities to assist ODS users in converting their operations to ODS-free methods. This paper identifies activities that may assist MB users in their phase-out efforts, drawing on experiences in several ODS sectors. Montreal Protocol projects in developing countries have shown that trials and demonstrations of MB alternatives can play a very useful role; other useful activities include the provision of information resources, use of economic signals, encouragement for companies to review their policies and contracts, and the development of new industries to provide alternative products and services in rural areas.

INFORMATION RESOURCES

Information about local alternatives

MBTOC, the Montreal Protocol's technical committee on MB, provides reports on existing and potential alternatives; of necessity this information is global in scope. MB users would benefit from additional local publications that focus on local MB uses and pests, and related alternative pest control methods. In Scandinavia, for example, the Nordic Council assisted MB users in the mid-1990s by publishing information on MB alternatives relevant to the region (Nordic Council 1993, 1995, 1997; Danish EPA 1997). In Australia, researchers met with local groups of growers to identify the most promising MB alternatives for local situations; they publish updates for growers, describing results of regional trials and demonstrations (Porter 2002).

Technical 'how to' booklets for farmers

Traditionally, extension organisations have provided practical booklets for farmers, detailing how to apply certain agricultural techniques. The Agriculture Ministry in Belgium, for example, published a series of booklets on production methods for strawberry, tomato, cucurbits, lettuce and ornamentals. Likewise, the University of California extension service publishes integrated crop production manuals in hard copy and on the internet for strawberry, tomato, cucurbits, cut flowers and other horticultural crops, as well as booklets on techniques such as solarisation.

In the post-harvest area, GTZ has published practical booklets on methods of stored product protection (GTZ 1996). Several 'how to' booklets have now been produced specifically on MB alternatives, and more are in the pipeline. For example, a leading tobacco company in Brazil has published farmer leaflets that describe how to build and use the floating tray system for tobacco seedlings. UNEP has recently published a manual on the production of cut flowers without MB (Pizano 2001). Many of the MB projects carried out by developing countries (under the Montreal Protocol) plan to publish practical booklets for growers, describing how to apply MB alternatives.

To assist MB phase-out in Europe, technical booklets could be produced at local level, giving details in a practical and user-friendly style, including diagrams, pictures and comments from growers who have experience with alternatives.

Lists of companies who supply alternatives

Farmers and other MB users need to know where they can find suppliers of alternative equipment, products and services; lists of companies and suppliers can provide a useful resource (Miller 1997). UNEP has published a series of Sourcebooks on suppliers of ODS alternatives for CFCs and halons, and recently published a similar Sourcebook for MB (Miller 2001). It lists examples of companies who manufacture and/or supply alternative products and services, and provides contact details of specialists.

Companies who supply chemical or non-chemical alternatives have an important role to play in MB phase-out. For EU users it would be useful to compile regional lists of suppliers of all types of relevant products, such as alternative fumigants, application equipment, cheap substrate materials, sheets for solarisation and biofumigation, organic matter for biofumigation, etc. Lists should include companies/organisations who provide related services such as pest identification, training in IPM and MB alternatives, alternative fumigation services, portable steam treatments, and technical advice on the control of soil-borne pests.

Brochures about new business opportunities

The Canadian government has noted that ODS phase-out provides an opportunity to develop new businesses and new industries, at the same time as benefiting the environment (Environment Canada 1996). Rural economic development programmes could consider identifying and distributing information about the business opportunities arising from MB phase-out, particularly opportunities for small and medium sized enterprises (SMEs) in rural areas. Since most countries import MB, there are opportunities for import substitution. There are also opportunities to develop new export sectors to meet the worldwide demand for MB alternatives.

Label information for MB users

Information on labels can help to inform and warn ODS users about the problem of ozone depletion, raising their awareness. Under the US Clean Air Act, for example, containers of MB and other ODS in inter-state trade are required to carry a special label which reads: 'Warning: contains [name of ODS], a substance which harms public health and environment by destroying ozone in the upper atmosphere' (Clean Air Act section 611).

ECONOMIC SIGNALS TO PROMOTE ALTERNATIVES

Levies and taxes to fund alternatives

Some countries have placed levies or taxes on ODS and pesticides in order to raise funds for the promotion of alternatives. From 1995 Australian MB users and importers introduced a levy on sales of MB to generate funds for trialing alternatives. At present the levy is about € 0.18 per kg and raises approximately € 134,000 per year, which is matched by funds from the government, giving about € 268,000 per year for the adaptation and improvement of alternative techniques and communications with growers (Porter 2002). The Czech Republic's ozone protection legislation placed duties of about € 6 per kg on imports of MB and other ODS, and the revenue is used by a state Environmental Fund for ozone layer protection (Parliament of the Czech Republic 1995). Also based on the 'polluter pays' principle, Denmark and Sweden have placed environmental taxes on sales of pesticides in general, raising funds for research on non-chemical and IPM techniques (MBTOC 1998).

Tax rebates for alternatives

Some governments have reduced import duties and company taxes on non-ODS equipment and products, to make investment in alternatives more attractive to ODS users. Malaysia and Singapore, for example, granted reductions in company tax for firms who invest in ozone-friendly technologies. India waived customs duties on imports of non-ODS manufacturing equipment (Miller 1999a).

Grants and subsidies

A number of governments promote agricultural innovation and exports by providing grants or subsidies for specific activities. These can give important economic signals to farmers and can help determine their choice of pest control methods, including MB or alternatives. The regional government of Ragusa in Sicily, for example, introduced a programme to promote new agricultural technologies - they subsidised the purchase of plastic sheets for solarisation (25% of cost reimbursed), and machinery (13% reimbursed) to lay plastic for open-field solarisation; irrigation systems were also subsidised (Vickers 1995).

The EU Common Agricultural Policy (CAP) has several funding mechanisms that could be used to assist MB users in the adoption of alternatives, such as: grants for investing in farming methods that reduce the polluting effects of agriculture, grants for training in agricultural practices for environmental protection and modern requirements. Several rural development programmes provide funds for advisory services, technical assistance and training, demonstration projects and pilot projects (Prospect 1997; Smeets 1998). It would help MB users in Europe if extension bodies or other groups would publish local/national guides to the agricultural programmes which offer assistance relevant to the adoption of MB alternatives.

COMPANY POLICIES

Companies who purchase large volumes of fruit, vegetables and stored products often set conditions or specifications for product quality and other parameters in their contracts with suppliers. Increasingly, environmental aspects are being considered. Food manufacturers, traders and supermarkets can play a positive role in identifying MB alternatives, reviewing their company policies and contracts, eliminating requirements for suppliers to use MB, and actively encouraging the adoption of alternatives (Miller 1999b).

Company policies

Some food manufacturers and supermarkets actively promote integrated pest management programmes, which can have an impact on MB use. For example, Sainsburys in the UK reported that its IPM programme did not permit the use of MB for certain crops, while in other crops MB use was being reduced (Prospect 1997). Some of Sainsburys' contracts specifically prevent the use of MB by suppliers. The Co-op supermarket organisation owns a number of farms in the UK, and banned the use of MB as a soil fumigant on these farms in the mid-1990s (Co-op 1996). The Co-op announced last year a new code of practice developed with its suppliers which will prohibit 24 pesticides including MB, as a result of rising consumer concerns about health and environmental impacts (Buffin 2001a). Marks & Spencer has announced a plan requiring its suppliers around the world to reduce and phase out the use of 79 pesticides that pose risks to health or the environment; MB is included in this list (Buffin 2001b).

In Spain, the Association of Harvesters and Exporters of Fruit and Vegetables in Almería (COEXPHAL) has had 25 years of experience in intensive horticulture in the south-eastern part of Spain. From 1997, growers have been requested not to use methyl bromide (MB) as a policy of the Association and today MB is no longer necessary for production (Fernandez 2002).

Environmental grading and certification systems

Industry environmental standards and certification programmes can assist the adoption of MB alternatives. For example, auction houses in the Netherlands have established an environmental certification and grade system for cut flowers, called MPS, in which farmers reduce their use of pesticides, fertilizer, water and energy. MB cannot normally be used in the production of MPS grade flowers. Around 5,000 farms implement the MPS programme in 22 countries, including the Netherlands, Belgium, Italy, France, USA, Israel, Kenya, Zimbabwe, Zambia, Costa Rica and Ecuador (de Groot 2001). "Eurepgap" standards in the European Community are promoting production of crops without the use of MB (Moeller 2002).

Consumer information

TEAP, an advisory body to the Montreal Protocol, has noted the role of environmental labelling in consumer decision-making on ODS and concluded that 'Parties [countries] that are not yet using eco-labelling systems to promote the objectives of the Montreal Protocol might consider the benefits of adding such a market-based measure to their ozone protection policies.' (TEAP 1997).

In the case of MB, some consumer and environmental organisations (eg. Natural Resources Defense Council in USA, Friends of the Earth, Pesticide Action Network) have pressed for the labelling of products grown with or without MB so that consumers will be able to exercise a choice when they purchase fruit and vegetables (MBTOC 1998). In several cases producers have placed labels on packages to inform consumers that MB has not been used. For example, GTZ agricultural projects in Jordan have developed a certified label for IPM products and those grown without use of MB. When the MB labels were trialed on packs of fresh strawberries exported to supermarkets in Europe, the retailer gave positive feedback and encouraged the producer to continue labelling products in this way (Hasse 2001).

Company leadership in the commercialisation of alternatives

TEAP has highlighted the important role of companies who decide to take a leadership role in the development and commercialisation of non-ODS products and services (TEAP 1997). In the 1990s in the USA, a pest control company called Fumigation Service and Supply took a leading role in trials and commercialisation of MB alternatives for commodities and structures such as food processing plants and flour mills (MBTOC 1998, Mueller 1998). In Peterborough Canada, the Quaker Oats food processing facility developed innovative and effective pest control systems based on sanitation, IPM and heat treatments; while the Canadian Pest Control Association has strongly promoted IPM MB alternatives since the mid-1990s (Health Canada 1998, Environment Canada 1995).

Certain governments actively encourage companies to take a leadership role in ODS phase-out. For example, the US EPA holds an annual award ceremony for companies who show leadership in ozone layer protection (US EPA 1997).

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ECONOMIC IMPACT OF METHYL BROMIDE PHASE-OUT IN THE UNITED STATES OF AMERICA

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ABSTRACT

As research has progressed on alternatives to methyl bromide (MB), the estimate of the economic impact of the U.S. ban on its use have been revised from \$1.5 billion annually to \$500 million annually. Using a value of marginal product approach as done here results in a loss estimate of \$624 million per year. Sixty-nine percent of the annual economic impact will be incurred when the final 30% reduction is required in 2005. Permitting quarantine uses and critical use exemptions under the harmonization of the U.S. Clean Air Act with the Montreal Protocol phase-out schedule may lessen the economic burden until new pest control strategies are adapted for use.

INTRODUCTION

The U.S. Clean Air Act requires the phase-out of any substance with an ozone depletion level (ODP) of 0.2 or higher. When the Montreal Protocol parties listed methyl bromide (MB) with an ODP of 0.7 (revised to 0.6) in 1992, the U.S. Environmental Protection Agency (EPA) instituted a ban on the production and importation of MB after 1 January 2001, permitting no exemptions for quarantine uses. When the Protocol parties adopted a phase-out schedule in 1997, the U.S. Congress amended the Clean Air Act to harmonize the U.S. and international schedules. Under this harmonization, the EPA has mandated a 25% reduction from 1991 levels in production, importation and consumption by 1999; a 50% reduction by 2001, a 70% reduction by 2003 and a 100% reduction by 2005. However, pre-shipment and quarantine uses of MB and critical and emergency use exemptions will be permitted after 2005. The U.S. EPA published an interim exemption proposal for quarantine and pre-shipment uses in July 2001. In 2001, the Montreal Protocol agreed to a time line as well as data requirement to determine critical use exemptions. The U.S. plans to solicit critical and emergency use exemption applications in early 2002.

Although it has reduced its use from a baseline of 25,528 tonnes in 1991 to 17,425 tonnes in 1999 (a reduction of 31.7%), the U.S. continues to account for 92 percent of the North American MB use (EPA, 2001a). These 17,000 tonnes of MB are used as a pre-plant fumigant, concentrated in tomatoes, strawberries, peppers, nursery crops, seed beds, grapes, and watermelon (Table 1). MB is also used to fumigate orchards and vineyards before replanting. Use is expected to decrease to less than 13,000 tonnes (49.1%) in 2001. Production is expected to decrease more than 10,000 tonnes in 2001 (EPA, 2001a). Part of this use reduction is due to the fact that the average price of MB in the U.S. has increased by almost 270 percent from \$1.23 lb in 1995 to \$4.50 lb in 2001 (UNEP/TEAP 2001).

Table 1: United States MB pre-plant use by crop (tonnes)

Crop	1997	Percent of Total Use	Estimated 2000 Use
Tomato	4409	25.6	3944
Strawberry	3889	22.6	2282
Peppers	1843	10.7	1261
Grapes	1382	8.0	376

Crop	1997	Percent of Total Use	Estimated 2000 Use
Nursery	1363	7.9	626
Seed beds	975	5.7	569
Watermelon	639	3.7	210
Almond	451	2.6	75

Two states, California and Florida, use more than three-quarters of pre-plant MB in the United States. Although MB is used on over 35 fruit, vegetable and nut crops in California, almost 70% is used for pre-plant treatment for strawberries, seed beds and nursery crops. Florida uses MB primarily on tomatoes, peppers, strawberries, eggplant, watermelon and in its double cropping systems. California's use has decreased 31.2% from 6,571 tonnes in 1991 to 4,522 tonnes in 2000; Florida's use has decreased 26.3% from 6,139 tonnes in 1990 to 4,522 tonnes in 2000 (CAPDR 1991, 2000, EPA 2001, NASS 2001). The use of metam sodium has almost tripled in California since 1990 – some of this increase was due to California prohibiting the use of 1,3-dichloropropene (1,3-D). Use of 1,3-D has increased dramatically since its reintroduction in 1994 and metam sodium use has decreased slightly (EPA 2001).

Previous economic impact analyses have been conducted examining the effect of an outright ban. In 1993, USDA's National Agricultural Pesticide Impact Assessment Program (NAPIAP) found the annual U.S. losses were \$1.3 to \$1.5 billion a year. Sunding *et al.* (1993) estimated California agriculture's losses to be \$162 million. Deepak *et al.* (1994) estimated that seven Florida crops' revenues (rather than loss of profits) will decline 54% from \$1.144 billion to \$524 million. Mexico's revenue is projected to increase by 65%. Carpenter *et al.* (2000) estimated economic losses will be almost \$500 million per year for pre-plant uses. Consumers of just 7 crops (cucumbers, eggplants, peppers, squash, strawberries, tomato and watermelons) will lose \$158 million per year in consumer surplus as prices increase when yields decline.

To analyze the new phase-out schedule, a value of marginal product approach was employed. Growers are assumed to be using the pest management technology that maximized the per acre net revenues. Switching to another pest management technology would likely alter the per acre yield and costs, and thus net revenues. The value of each pound of MB for annual crops could be computed using the change in net revenue from the price-weighted changes in per acre yields and changes in per acre costs, assuming growers would shift to the next best alternative pest control strategy outlined in Table 2 and Carpenter *et al.* (2000). This value determined the highest-value use of MB and thus which crop/region combination would continue using the chemical as each stage of the phase-out becomes binding, assuming the most efficient allocation of the chemical is employed.¹ For perennial crops, the value of marginal product was calculated similarly using the change in net revenue over time assuming a discount rate of 4 percent for the expected length of the crop's life. Fifty-two crop/region combinations were examined including nurseries, seed beds, and double cropping systems in 6 states (California, Florida, Georgia, North Carolina, South Carolina, Tennessee). Values were computed for four distinct growing regions in California and five regions in Florida. These uses represented approximately 71 percent of the 1997 use of MB in the United States. Average prices, costs per acre, and yield assumptions can be found in Carpenter *et al.* (2000).

¹This approach assumes constant prices, which may not be realistic if yield and acreage changes are large. Growers may find that the relative profitability of a crop changes and switch to another crop. Depending on price elasticities, price changes may compensate for some of the decreased yield and/or increased costs following the switch to another fumigant.

RESULTS

On a per pound basis, California strawberry growers had the highest value for MB (\$55/lb) compared to the next best pest control strategy. California premium wine grapes (\$54.36/lb), almonds (\$47.03/lb) and Florida strawberries (\$34.27/lb) also had high values. In the first round of the phase-out, some acreage went out of production due to competition from Mexico and other U.S. growing areas. Some California growers, such as carrot growers, shifted to using the reintroduced 1,3-D. Florida tomato growers decreased use by over 1000 tonnes (27.2%), strawberry growers decreased use by 9.8%, and pepper growers decreased use by 25% in 2000 compared to 1990. California nursery growers reduced use by 277 tonnes (30.7%) and strawberry growers by 139 tonnes (6.8%) in 2000 from 1991 levels. Seed beds increased use by 289 tonnes (103%) in 2000 from its 1991 level. The implicit cost of this 25 percent reduction was \$46.5 million annually. The threshold value of marginal product was \$7.74/lb. The price of MB rose 103%, from \$1.23/lb in 1995 to \$2.50/lb in 1999.

Table 2: Best Alternative Pest Control Strategy to MB¹

Crop	Pest Control Alternative	Yield Loss (%/acre)	Cost Change (\$/acre)
Eggplant	Telone C-17 +Napropamide	15%	\$23.11
Pepper	Telone C-17 +Napropamide	12.5%	\$23.11
Strawberry	Telone C-17 +Napropamide in Florida	21.5%	\$448.73 Cent. FL
	Chloropicrin +Vapam in California		\$697.50 C. Coast CA
			\$597.50 S. Coast CA
Tomato	Telone C-17 +Pebulate in Florida	10.0%	\$13.36
	Vapam+Pebulate in Dade County, FL	17.5%	-\$60.39
	Telone II in California	10%	\$0.00
Watermelon (Single/Double crop)	Telone C-17 +Bensulide +Naptalam	15/17.5%	\$96.00
Squash (Double crop)	Florida	17.5%	
	Dade County, FL	22.0%	
Cucumber (Double crop)	Florida	17.5%	

¹ Yield and cost change assumptions for perennial, ornamental and nursery crops were also based on Carpenter, Gianessi, and Lynch (2000).

The 50 percent reduction was also accompanied by a significant increase (80% from 1999; 270% since 1995) in price for MB to \$4.50/lb. The additional reduction increased the implicit loss to \$114 million, an increase of \$67 million. The threshold value of marginal product was \$9.51/lb. The next phase-out level of 70% will impose an additional \$81.9 million in losses, bringing the total cost to \$195.9 million. The threshold value of marginal product was \$15.09/lb. If the price increase follows the same trend, the 58.7% increase in the threshold value should result in a 205% increase in the price of MB to \$9.23/lb. The largest losses from the phase-out occur with the reduction of the last 30 percent. This additional reduction imposes a cost of \$427.8 million, bringing the total cost of the elimination of MB to \$623.6 million per year. These last 4305 tonnes have values of marginal product ranging from \$15.11 for Central Florida's double cropping system of tomatoes/cucumbers to \$55.07 for California's South Coast strawberries. If these crop/region combinations qualify for critical use exemptions until more economical alternatives are found, the annual economic impact will be lower. In addition, strawberry prices may increase following a 21.5% reduction in yields, which will decrease the economic hardship to growers but impose costs on consumers.

TABLE 3: Economic Impacts of Phase-out

Percent Reduction	Range of Value (\$) of Marginal Product per pound of methyl bromide	Incremental Cost (\$)	Total Annual Cost (\$)
25% (1999)	1.90 - 7.74	46,535,8	46,535,812
50% (2001)	7.81 - 9.51	67,412,3	113,948,143
70% (2003)	9.70 - 15.09	81,906,1	195,854,327
100% (2005)	15.11 - 55.07	427,764,41	623,618,741

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THE ECONOMIC IMPACT OF THE PHASE OUT OF METHYL BROMIDE ON HORTICULTURAL PRODUCERS IN HUNGARY

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ABSTRACT

Horticulture and mainly vegetable growing is a very important sector of Hungarian Agriculture, especially if export is considered. Szentes contains the largest agricultural area in the world that produces crops year-round using thermal energy from natural underground water supplies. The most important vegetable crops are white-yellow sweet paprika, tomatoes, Chinese cabbage and other brassicas, hot green paprika (pepperoni) and cucumber. Methyl bromide (MB) has been used to control soil borne pathogens in vegetables, mainly nematodes under glasshouses and heated plastic tunnels, and in few cases under non-heated plastic tunnels, since its registration in the mid 1980's. Approximately 27 tonnes of MB are used in Hungary. The tobacco industry eliminated its use of MB in 1999 when it adopted the floating bed technology for rearing seedlings. Rockwool combined with grafted plants offers the best promise for eliminating the remaining uses of MB in this sector by 2005.

Keywords: economic impact, phase out, geothermal energy, Hungary

INTRODUCTION

Árpád Company, founded in 1960 as a Vegetable Growing Co-operative, is one of the top Hungarian agriculture companies. The company first produced open-air crops and later crops grown under glass and plastic. Today Árpád is no longer a cooperative as for political and economical reasons the company was changed to an Incorporated Share Company in 1999 with a founding capital of about € 11 million. Árpád has about 1 200 shareholders (majority of them previous coop members), but 70-80 shareholders could make the important decisions as they have more than 50% majority.

Szentes in Hungary and the surrounding area has a tradition in vegetable production going back centuries. Gardeners from the present Bulgaria immigrated to Hungary in 18th century and established a new method of vegetable production with intensive irrigation between the rows. They also brought with them their new types of vegetables not previously grown in Hungary. These gardeners delivered their products not only in towns in Hungary but delivered as far as Vienna.

The Bulgarian gardeners settled in the Szentes area because of the good quality soil and irrigation water from nearby rivers and irrigation canals. Sunshine hours equate to more than 2 050 hours per year. Geothermal energy was also abundant locally which enabled vegetable production throughout the year under glass and plastic. Szentes developed in the 1960's and 1970's as, during this period, thermal wells were drilled and used for heating greenhouses. It is unambiguous – that despite the continuously growing energy costs and taxes – only the geothermal energy made it possible for large-scale, profitable vegetable production under glass and plastic. Today, 14 thermal wells are operational sourcing hot water from average depth of 2 000 m at a temperature 78-96°C and a flow of 60-70 m³/hour.

PRODUCTION AND MARKETING

Thermal water is used to heat 46 hectares of glasshouses and plastic tunnels, as well as animal farms, a grain drier and social buildings. This is the world's largest agrarian project heated only with geothermal energy. More than 500 families are growing vegetables – with the technical assistance of our horticultural engineers - using 23 ha glasshouses, 23 ha of heated plastic tunnels, 40 ha of non-heated plastic tunnels and on 50 ha in the open air. The total amount produced is around 10 000 tonnes a year for a turnover of about € 6.7 million.

Crops

Árpád's most important crop is the white-yellow sweet paprika (cone shaped). The varieties are mainly Hungarian hybrids. This paprika is grown and sold each day of the year and is

produced under glass, heated plastic, and non-heated plastic tunnels. Professor Szent-Györgyi Albert won the Nobel Prize in 1937 for synthesising vitamin C from paprika grown in nearby Szentes and Szeged.

The next important crop is the tomato, which is grown under glass (spring and autumn) and under heated plastic tunnels. The varieties are the different Dutch varieties. On smaller acreages, hot green paprika (pepperoni) and cucumber are produced in glasshouses.

The typical main crop under non-heated plastic is the yellow sweet paprika. As early spring crops Chinese cabbage and other Brassicas are produced which are harvested in April and May. In the open air (partly covered by a plastic layer), Chinese cabbage and other Brassicas, Onion, Spice Paprika for milling are also produced.

Árpád has a well-trained, effective plant protection and production technology Advisory Service Team which helps Árpád to integrate the small individual growers. Altogether some 1,500 to 2,000 small producers are integrated in this way.

Certification

The Company Det Norske Veritas certified our vegetable production and sales according to the ISO 9002 Standard in 1998. HACCP certification is also under preparation (it has been completed for Chinese cabbage and paprika). We also started to build up the ISO 14000 Standard for our horticulture production and sales and an audit is planned for February 2002.

Coolstores

Árpád has coolstores where products are prepared for shipment for the home market or for export. One of the coolstores was modernised in 2000 and follows the newest EC standards of environmental friendliness.

Exports

The products of Árpád and products sold through the integration with other companies are well known in Germany, Scandinavia, Slovenia, Slovakia, Czech Republic and Austria. The number 1 export article is the yellow paprika. This product has the right to use the common Hungarian brand: "Quality Food from Hungary". From our total turnover of €6.7 million, about 30-40% is derived from exports and the remainder from the home market. Products of other companies can also be coolstored by Árpád.

Integrated Pest Management

Árpád started an Integrated Pest Management Programme several years ago to address the requirements of customers abroad and in Hungary who were more interested in healthy products free from chemicals.

Bumblebees are used for better pollination and beneficials to control the different harmful insects. Árpád is a distributor with exclusive rights for a Belgian company on this field.

In 2000, the operation was so successful that no chemical treatment was needed at all in some of Árpád's glasshouses involved in the project. In 2001 the start was not as easy as too many insects survived the mild winter, so sprays had to be used against thrips and other insects.

METHYL BROMIDE USE AND PHASE OUT

Methyl bromide

There were more and more problems with soilborne pests and diseases, especially with nematodes and thrips, as Árpád had old production facilities and a monoculture type of growing. Árpád was one of the first companies in Hungary to obtain the right to use MB in the mid-1980's for disinfection of soil in greenhouses. Árpád has well-trained personnel to fumigate safely and equipment to distribute the gas.

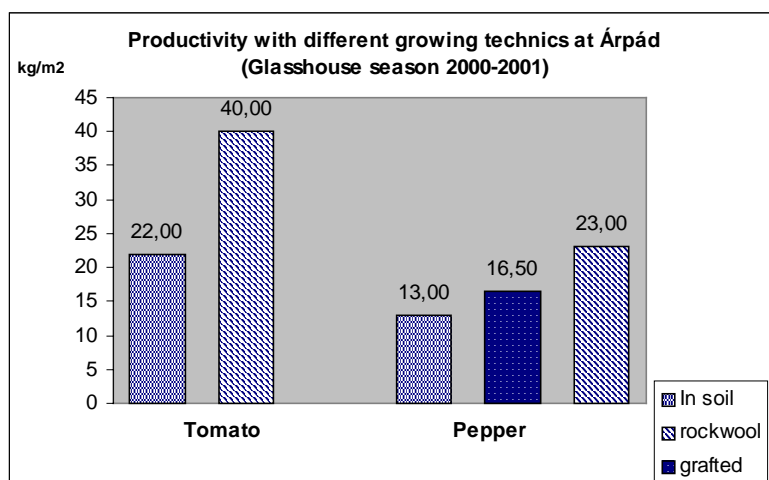
During the years of monopolised foreign trading Árpád bought MB from Chemolimpex Foreign Trading Company. After the political and economical changes, Árpád applied to the Ministries of Agriculture, Environment Protection and Foreign Trading to import MB directly which resulted in cheaper MB. Zephyr Ltd. and the tobacco industry have also obtained licences for

importing but today only ÁRPÁD and Zephyr require the use of MB which is 27 tonnes per year.

Substrates for production

As Árpád became aware of the Montreal Protocol and its phase out requirements for MB, it started to modernise its greenhouses to allow for soilless rockwool technology. In 1998, a pilot glasshouse of 3,600 m² was prepared to grow tomato on rockwool. As the results were good Árpád increased the area of tomato in 1999 to 1ha. In 2000, paprika was grown for the first time on rockwool on 2 ha. and expanded to 6 ha in cooperation with the Ministry of the Netherlands in 2001. In 2002, a further 4 ha investment using rockwool was completed consisting of 2 ha paprika, 1 ha tomato and 1 ha cucumber. Currently, 11 ha of rockwool is in production and Árpád plans to increase this further. Of course, the investment costs and support for modernising such an old operations have determined the speed with which MB could be eliminated (see data in Table 1 and Figure 1).

Figure 1: Productivity with different growing techniques at Árpád.



Grafted plants

The heated plastic tunnel units were too small with little air space, uneven heating and had problems with irrigation water quality requiring filters. These factors made production on rockwool very difficult. Grafted plants seemed to offer a way to overcome these limitations.

The first trials were made in 2000 using grafted paprika culture under heated plastic. Grafted plants were bought from Italy. The root plant was Snooker and the producing plants were traditional varieties. The much stronger and bigger root mass supplied the upper producing plants with more water, feed and minerals. The stronger crop was more resistant to stress and to any disease, virus, and bacteria. The larger root was more tolerant of nematodes and consequently a much larger leaf mass was developed with larger yields. To save costs, the bigger roots allowed the use of two main stems rather than one in the traditional growing method.

The Regional Demonstration Project conducted in Poland, with the help of UNEP, could provide alternative chemicals and growing techniques. Grafted paprikas combined with some chemical treatments could bring good results under non-heated plastic tunnels. Possibly all greenhouses will be equipped with rockwool by 2005 allowing the elimination of MB at this time.

Information transfer

Árpád has organised each year at least two workshop days - one in Spring and the other in Autumn. Growers are invited from all over Hungary. Specialists from abroad make presentations. In 2001 the subjects were: "Soilless paprika growing under greenhouses and the new technology with the grafted plants". Árpád also has a newsletter sent to all growers

involved in production. Árpád specialists write articles for the growers in various periodicals such as "Horticulture and Vinary", "Plant protection", and "Hungarian Agriculture".

Costs

Table 1 is summarises the results of the new techniques. The operating costs were higher on rockwool and with grafted plants, but it was still profitable. Investments costs can be recovered in a maximum of 4-5 years.

Table 1: Summary of economic impact Comparison of yields, incomes of different cultures and growing methods (Glasshouse season 2000-2001)

CRITERIA	TOMATO		PEPPER		
	In soil	Rockwool	In soil	Grafted	Rockwool
Yield kg/m ²	22 ¹	40	12-13 ²	16,5	22-23
Income Ft/m ²	3 800	6 000	2 800	3 700	6 000
Mbr cost Ft/m ²	190	-	190	190	-
Investment costs Ft/m ² ³	-	5 000	-	-	5 000

¹Tomato in soil 2 crops spring and autumn; ²One spring crop only; ³Investment costs include: Soil removal 5 000 m³/ha, in order to increase the possible height of the crop; Change of old isolation, broken glasses; New heating system; New drip irrigation system; New irrigation water cleaning system; New irrigation water distribution system. 1 EUR = 239.605 Hungary Forints in February 2002.

It was difficult to make economic analyses about the private plastic growing units because:

- Ownership changed and no data were available;
- Different heating possibilities, consequently different planting periods, different cultures, different harvest results, and incomes;
- Different inputs;
- The level of integration differed; and
- Lack of any state subsidies.

Despite these facts, I am sure that Árpád's growers will find the optimal solutions for themselves to survive after Hungary joins the European Community. I am confident that growers could carry on a profitable production, even to develop their production facilities and growing techniques and do well without MB.

ECONOMIC EVALUATION OF METHYL BROMIDE ALTERNATIVES USED ON THE EAST COAST OF SPAIN

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ABSTRACT

Growers need alternatives to MB that are safe, consistent and cost-effective. Several projects were undertaken in the Mediterranean coast of Spain (Valencia and Murcia) to evaluate the cost of products and techniques tested as alternatives to methyl bromide (MB) on crops such as citrus, open-air horticulture, strawberry, and greenhouse-grown pepper. Telone (1,3-dichloropropene with chloropicrin) gave the most consistent and reliable results. There is interest in solarization, particularly when combined with chemical or biofumigants at low dose, however, in greenhouse-grown peppers have other costs associated with reducing the harvesting period. The use of grafted plants is a solution for watermelon and offers possibilities in other species. To compensate for possible increased costs for alternatives, Integrated Crop Production can be a solution as this adds value in some markets.

Keywords: Horticultural crops, chemical alternatives, solarization, grafted plants, integrated crop production.

INTRODUCTION

The favourable climatic conditions on the East of Spain and its proximity to the European markets has proven attractive to the horticultural industry. Horticultural production has expanded and competition has increased. The structural and economic change of the horticulture has been spectacular and the evolution in production methods has led to greater specialisation. Greenhouse production and other intensive cultivation techniques have increased in most arid provinces due to the advantages of stable climate and sunlight. One of the consequences of this specialisation is a trend towards monoculture, intensification of the use of the soil and the disappearance or reduction in rotation crops.

Monoculture is a consequence of the internal economies of production and of other externally-derived factors driven by the market place. Repeated cultivation on the same land has forced growers to disinfect soils of a range of pathogens (see Cebolla 2001; Katan 2000) using methyl bromide (MB) for crop production security.

The elimination of MB has required us to intensify the research and development of alternatives. Among the studies that are being carried out in Spain, INIA SC97-130 and the projects IVIA-5706 and IVIA-5012 are some of the most important. As part of these studies, we report here the viability and cost of several alternatives to MB. Added to this analysis is a section on Integrated Crop Production (ICP) and how its introduction affects soil disinfestation.

CULTURES AND TREATMENTS

Soil disinfestation using MB is carried out on commercial production properties in the East coast of Spain when re-planting citrus (infrequent MB application); in horticultural crops (necessary occasionally); in strawberries crops (very often); and in greenhouse-grown pepper (essential). These four groups were introduced into the Work Plan in order to find alternatives to MB prior to the ban on its use.

An economic evaluation was performed on the results in the technical reports taking into account: 1) The total costs of every treatment (product and application); 2) The cost-benefit obtained from the treatments due to sales in the market; and 3) Risk of crop loss or reduction in yield. We also took into account the external costs such as the type of alternative, its impact on the ecosystem and its benefit to society, the difficulty of applying the alternative and the possibility of adoption by growers.

Citrus

The trees killed by tristeza virus are replanted on the same land. Disinfestation with MB is carried out to avoid problems with a number of disease problems including Phytophthora and soil sickness (non-specific replant disease). The treatments also aim to increase production. Zaragoza *et al.* (2001) used nine treatments to measure the development of the trees and the productions over three consecutive years (1999, 2000 and 2001). From this information, it was possible to say that :

- Non-disinfested land did not induce more tree deaths than disinfested land;
- Tree vigour in disinfested plots was not reflected in increased income, especially if the soil disinfestation was delayed for more than one year ; and
- The lost income when planting was delayed one year was less than the disinfestation cost.

It was difficult to be definitive as different species of nematodes or fungi may make disinfestation more worthwhile. Citrus work will continue and the results will undergo further economic analysis.

When the plot is registered in ICP there are regional regulations that prohibit the use of chemical disinfesting.

Open-air horticulture

Agrarian systems are important with typical crop rotation under intensive production, up to three harvests per year. As an example, the production of the earth almond *Cyperus sculentus* is one of the most important. The use of MB in this crop is required to control unknown diseases localised in the soil due mainly to repeated cultivation on the same land and to control a remainder *Cyperus sculentus* crop that is difficult to eliminate after harvesting and becomes a weed. Cebolla *et al.* (2000) showed the effects of the MB and four alternative treatments, based on INIA project SC 97-130 and IVIA 5706.

From the economic viewpoint, there are suitable alternatives to MB using, for example, solarization combined with manure or metam sodium at lower doses, or Telone combined with metam sodium or chloropicrin. MB was best at weed control and its use in this area could be relatively low. Notably, each alternative gave a number of problems suggesting more experimental information will be required before MB can be eliminated. The profit from each of these crops is minimal and severely restricts the choice of alternative.

Grafted watermelon was an example of a successful alternative to MB which has been accepted on a commercial scale. Repeated growing of grafted watermelon on the same land did not produce any negative effects. Grafted watermelon was 798.34 euros per hectare cheaper than MB disinfestation.

Strawberry

Production area has declined in Valencia because the expansion in Andalucia. The farms remaining in Valencia are mostly operated by families. MB disinfestation is reported to improve quality and consistency of production. The data have been analysed from a technical perspective (Cebolla *et al.* 1999) and from an economic perspective (Caballero *et al.* 2000). For two growing periods and based on a sound statistical design, eight treatments were investigated which included a non-disinfested (control), two MB treatments and other five alternative treatments. Proportional indexes were developed taking as a base 100 the traditional treatment of MB-60.

In the first year, solarization combined with manure (6 kg/m²) and metam-sodium gave yields similar to MB, but these results were not repeated in the second year. Traditional MB and MB at half dose with plastic VIF gave similar results. Metam-sodium without solarization resulted in lower yields. Biofumigation with high doses of manure gave inferior yields in both years to the non-treated control.

Once the yield from the different treatments had been compared, other factors were considered such as the costs of the treatments, prices in the market, and the cost of applying the alternative in order to build a representative economic model of the productive system in the Region.

The results show that profit margins are very narrow and a minimum yield is required in order to recoup the high capital costs of disinfestation, acquisition of plants and hand labour. Given the high proportion of the variable costs, the differences in the costs of disinfestation among the treatments did not allow us to produce decisive economic analyses. However, disinfestation only when required is an option that farmers will need to consider in the future in order to avoid production costs that cannot be recovered.

Greenhouse-grown peppers

This crop has the greatest dependence on MB. Alternatives examined include MB with and without VIF, solarization combined with manure, chemical products at lower doses, and use of grafted plants. The results have been reported under project INIA SC-97 130 which included the Campo de Cartagena (Murcia) and the Co-operative SURINVER of Pilar de la Horadada (Alicante).

Data were collected over several harvest and indices established allowing comparison between MB and non-MB treatments. Weekly cash flows based on market prices to the co-operatives permitted an evaluation of the cost-effectiveness of the different treatments.

From the alternatives studied, the best was 1,3-dichloropropene and chloropicrin (Telone C-35) which had profits similar to MB and, in some cases, superior. Solarization reduced the doses of other products used in combination but it was difficult to get the same results across several growing periods. In the first place, the yield was lower than that obtained with Telone C-35. In addition, there was a yield decline of 20-24% due to the lack of production in August and September. The overall decline in income was 11-15% using solarization. It is necessary to take into account that all the expenses, except harvesting, have already been done and the fixed costs are the same for the whole year.

This procedure can result, very useful, in the years in which at the first of August could have finalised the productive life of the crop because of virus or other causes. Solarization is a good basis on which to promote ICP.

The economic evaluation of one plot with grafted plants showed that the method appeared promising despite yield and profit being less than those obtained with MB and Telone-C35. Grafting is also a good basis on which to promote ICP.

Greenpepper production using substrates accounts for 10% of production with the potential to increase further when high-quality water is present and growers are technically competent. Yield is usually 40% more, and current prices 25% more, than greenpeppers produced in the soil.

INTEGRATED CROP PRODUCTION

Efficient production is countered by consumers who are preoccupied by product quality, pesticide residues and environmental damage. ICP attempts to address consumer concerns by being based on ecological production, sustainable agriculture and economically viable treatment methods. ICP calls for the rational use of inputs, regulation of agrosystems, sale of a competitive product and security of food supply. Soil disinfestation, common in intensive production, is one of the cultural practices most limited by the ICP.

ICP envisages the use of all the possible methods in intensive, horticultural production. The regulations can include chemical disinfection as long as this is justified and authorized. It is recommended in the regulations that chemical disinfestation should not occur over the same plot in two consecutive years.

The reduction of residues in the product favours its sale for good prices that can compensate for moderate increases in the costs of production and in the near future, the commercial quality will be guaranteed with traceability from plot to market. ICP products have greater acceptability and can be commercialised within the normatives EUREP-GAP. The members of EUREP represent in Europe one important part of the large surfaces. ICP is the best instrument for a holistic cultural practice and the results submitted to the laws of supply and demand in the market place.

CONCLUSIONS

Viable alternatives have been found for MB but with limitations and differences for security of production. Despite some application problems, various combinations of Telone (1,3-dichloropropene) with chloropicrin have been shown to be safe and consistent with an economic impact similar to MB. Solarization gives better pathogen control when combined with chemical disinfectants at low doses or with manure, and economically this is effective too. Solarisation in glasshouse-grown peppers is acceptable for ICP but production should cease after the first days in August, with economic repercussions, having to do without the harvests in August and September.

Grafted watermelon is a viable alternative. Grafted tomatoes and melons remain possibilities for the future. Grafted pepper appears very interesting for the future, especially in ICP. Telone C-35 currently provides the grower with a secure, chemical alternative with the best results.

MB set an internal economy for pest control on the farm. Regulatory restrictions cause economic diseconomies. One solution to avoid higher costs could be the massive introduction of the ICP, as this will enable farmers to get higher market prices, which will help to compensate for the costs of the alternatives.

Combinations of alternatives can reduce the secondary effects and the external costs, even those growers using small amounts MB when it is not eliminated totally. On the other hand, it is not absolutely convenient to base an economic activity on a production factor that is difficult to substitute such as MB with his future elimination (Katan, 2000).

It is possible to increase considerably crop production using substrates without expanding the total area.

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SOUTHWESTERN SPAIN STRAWBERRY GROWERS AWARENESS OF THE METHYL BROMIDE PHASE OUT AND THEIR WILLINGNESS TO PAY FOR ALTERNATIVES

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INTRODUCTION

The ban in the immediate future on the use of methyl bromide (MB) in soil disinfection may cause a short-to-medium term increase in production costs for some farmers. Farmers most affected in Spain are those producing strawberries, cut flowers and nursery crops and, to a lesser extent, plastic covered horticulture producers. This paper reports on the results of a survey carried out on more than 500 strawberry growers in south-western Spain to analyse their situations, attitudes and willingness to pay (WTP) for a hypothetical MB alternative of similar disinfecting powers. The study identifies the factors which determine the WTP.

METHODOLOGY

A survey was carried out on 504 strawberry producers in the area of Huelva (south-western Spain). The questionnaire used contained questions on the structure of the farms, aspects concerning the adoption of innovations and management, sociocultural characteristics of the grower, soil disinfection procedures, and their willingness to pay (WTP) for a hypothetical alternative to MB.

Two Probit Binomial and Multinomial Ordered Dependent Variable Models were used to identify the factors determining both the fact of having or not WTP, and the amount to be paid. The same explanatory variables have been considered for the two models as follows: S: Farm Surface; AI: Attitude towards Innovation; IPA: Integrated Production Acquaintance; AS: Attendance to Seminars on methyl bromide; YF: Years as a Farmer; FA: Formation (formal studies) in Agriculture; VI: Technical visits to other areas in Spain or abroad; LA: Reads technical Literature (books) on Agriculture; and A: Age of grower

RESULTS

Attitudes and opinions of growers

Figure 1-a shows the distribution of chemicals that have been used in the area to disinfect the soil. We see a prevalence of MB used only in beds. By observing the current distribution in Figure 1b it becomes clear that this is a growing trend to the detriment of all surface MB and of metam-sodium disinfection.

As far as dosage is concerned, Table 1 shows that, at present, the prevailing quantity of MB only beds is of 200 Kg/ha. When applied to all surface, the dosage rises to 350-400 Kg/ha. Table 2 shows the self-evaluation of results of the three technologies most often used: in view of this self-evaluation (B: bad, V.G: very good) it is easy to understand why the use of MB is favoured, and also that the treatment only in beds is on the increase, since it only requires approximately one half of the dosage used on all surface, and the two distributions of results frequency do not differ significantly ($\alpha \geq 0.01$).

Almost all (97.62%) strawberry producers use MB as soil disinfectant, and most of them (86.71%) consider the ban on MB a serious problem that is going to harm their business. Only 6.55% are confident that an equivalent alternative treatment will be available soon. However, the majority (94.98%) express their unwillingness to stop growing strawberries, even if they have to discontinue MB use.

Of the criteria influencing their decisions on which disinfecting techniques farmers intend to adopt, the environmental impact was a criterion of little importance to producers. The main factors important to farmers were, in order of priority, yield and the commercial quality of the fruit (Table 3). Almost all farmers (98.41%) believed that soil disinfection was indispensable for ensuring steady production. Most (92.7%) farmers thought that, in the case of strawberries, there were currently no alternative technologies to MB with similar disinfecting power. Most farmers believed (82.25%) that MB harmed the ozone layer and, moreover,

most (82.67%) thought that it was noxious to the operator applying it. At the same time farmers agreed (95%) that MB improved strawberry quality.

Willingness to pay for an alternative to methyl bromide

In relation to the willingness of farmers to take on additional per-hectare cost for having a MB alternative of similar disinfecting power but harmless to the ozone layer, 72.62% of the farmers presented a positive WTP, while the rest (27.38%) were not willing to pay more. Those not willing to pay more thought that it was not worth the extra cost if production was not increased (15.95% of the farmers), they would like the alternative but they could not afford to pay more (9.03%) or that society should pay as this was an environmental issue (2.4%). The “protest answers” represented only 2.4% of the total farmers which could be interpreted as an implicit acceptance of their responsibility by 97.6% of farmers to eliminate MB. The remaining reasons for not showing a WTP were related mainly to profitability.

Distribution figures for the 72.62% of farmers who show WTP can be seen in the Figure 2. Average value is 342 (341.75) euros/ha and its variation coefficient is 0.59, the highest value being 1200 euros/ha and the lowest 60 euros/ha (apart from zero values). The data show that 61% of the values are between 240 and 360 euros/ha.

WTP value includes in this case two value components that are not easily separable. On the one hand, producers' interest in seeing themselves free of a problem posed by the use of MB which they know is going to be banned and, on the other hand, their awareness of the damage they cause. In any case, it is clear that the main component of the value represented by the WTP is the MB ban since minimising environmental damage did not constitute an important criterion among most producers.

From the data, the average WTP for all producers would be 248.36 euros/ha which means that an additional cost of this amount would be readily acceptable to the average farmer in the area.

Other explanatory variables

Results from the binomial Probit model indicate that only S, AI and IPA show a significant correlation to the fact of presenting or not WTP.

With respect to S, a “non-continuous WTP scale effect” was detected. Farm owners who grow more than 8 ha of crops displayed greater probability of having WTP than farmers who produce on a smaller surface scale. Also, farmers who are more prone to adopt innovations once they have analysed their feasibility, and without waiting for most other farmers' successful reports, usually present WTP more frequently. Likewise, farmers acquainted with integrated strawberry production present greater likelihood of having WTP.

Result from multinomial ordered Probit model showed that, within growers with positive WTP, age, attendance at MB alternative seminars and visits to agricultural areas were significantly correlated to WTP. A grower aged between 25 and 35 had the highest WTP values. No significant scale effect ($p \geq 0.95$) was detected. Numerical figures concerning the estimation of the models can be seen in Calatrava (2001).

ACKNOWLEDGEMENTS

The work has been made under the scope of the INIA SC97-130 Lopez-Aranda (1999).

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Table 1: Distribution of dosages (kgs/ha) used for soil disinfection in Huelva strawberry plantations

Methyl bromide (Only beds)		Methyl bromide (all surface)		Metam-Sodium (Different ways)	
KGS/HA	%	KGS/HA	%	KGS/HA	%
100	1.04	150	1.0	100	10.52
150	9.66	200	1.0	400	31.57
200	77.56	250	2.0	500	15.80
225	0.26	300	5.0	667	5.26
250	6.26	350	31.0	700	15.80
300	1.56	359	1.0	833	15.80
350	1.30	375	1.0	1000	5.26
400	1.30	400	53.0		
450	0.53	450	4.0		
500	0.53	500	1.0		

Source: Project SC97-130

Table 2: Self-evaluation of results of technologies for soils disinfection most often used in Huelva strawberry plantations

Self-evaluation of Results	Methyl Bromide (only beds)	Methyl Bromide (all surface)	Metam-Sodium (different ways)
Very Good	60.57	69.00	--
Good	33.42	28.00	57.89
Bad	5.48	3.00	26.31
Very Bad	0.53	--	5.26

Source: Project SC97-130

Table 3: Assessment of the importance of criteria (0=Not important, 5=Very important) in the choice of soil disinfectant techniques (% of growers).

Criterion/Score	0	1	2	3	4	5
Greater production	-	0.60	1.98	14.68	30.95	51.79
Higher commercial quality of the fruit	0.20	0.99	6.76	28.97	40.28	22.82
Diseases reduction	0.40	12.50	19.84	26.39	19.25	21.63
Lower treatment cost	17.86	9.72	42.46	20.44	6.55	2.98
Fewer residues	4.76	58.73	24.80	8.53	2.78	0.40
Lower environmental impact	76.79	14.46	4.37	0.79	0.20	0.40

Source: Project SC97-130

Fig. 1a: CHEMICALS THAT HAVE BEEN USED FOR SOIL DISINFECTION IN STRAWBERRY IN HUELVA AREA

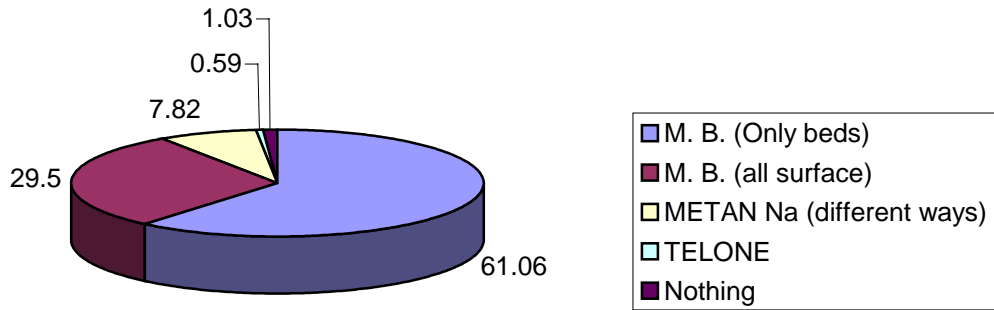


Fig. 1b: CHEMICALS CURRENTLY USED FOR SOIL DISINFECTION IN STRAWBERRY IN HUELVA AREA

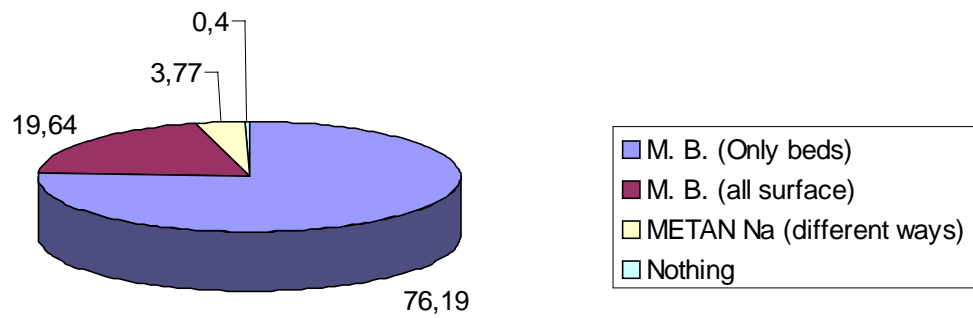
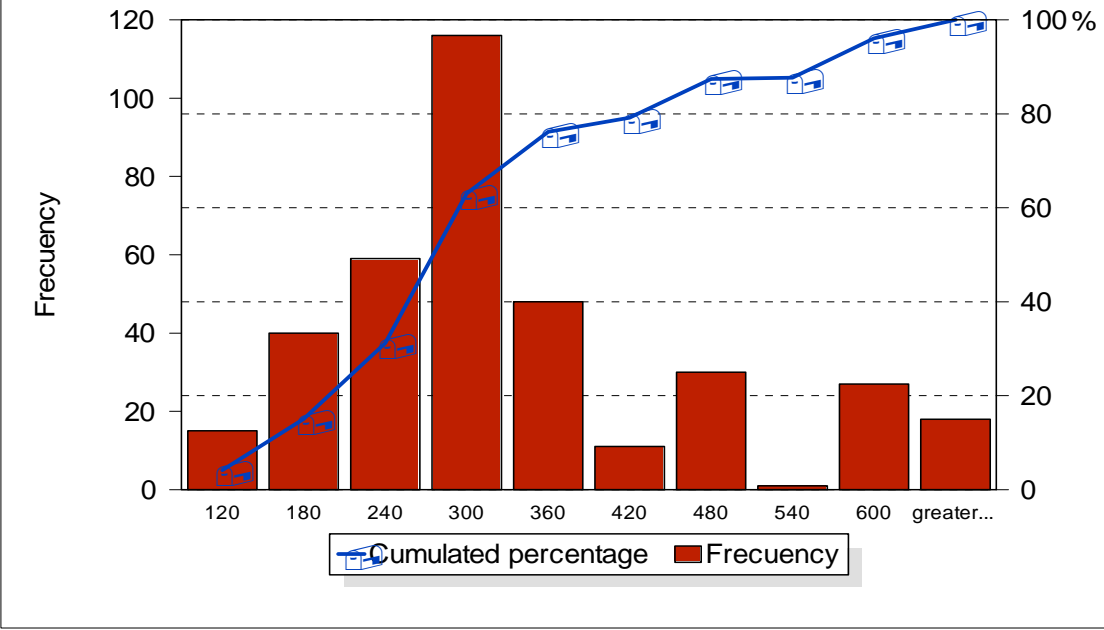


Fig. 2

DISTRIBUTION OF THE WTP (Eu./ha) FOR AN ALTERNATIVE TO M.B.



“EUREPGAP” STANDARDS - PROMOTING SAFE AND SUSTAINABLE AGRICULTURE INCLUDING ALTERNATIVES TO METHYL BROMIDE

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ABSTRACT

EUREPGAP provides global agricultural production standards and a verification framework for fruit and vegetables to retailer and supplier members. A “Steering Committee” and a “Technical & Standard Committee Fruit and Vegetable” undertake a continuous review of supporting documents and procedures. Certifiers accreditation to ISO standards based on “EUREPGAP Fruit and Vegetables” has recently been achieved. EUREPGAP requires written evidence from growers for the use of soil fumigants such as methyl bromide (MB) including information on the location, date, active ingredient, doses, method of application and operator. EUREPGAP recommends a grower demonstrate to the certifier that alternatives to MB have been explored by showing their technical knowledge and written evidence of alternatives to soil fumigation. EUREPGAP requires chemical fumigation of soils to be justified and used only as a last resort. EUREPGAP recommends alternatives to MB such as crop rotation, planting of break crops, use of disease resistant cultivars, solarization, conversion to soil-free cultivation and similar techniques. EUREPGAP “Recommendations” are currently voluntary but may become compulsory in the future.

INTRODUCTION

The Euro-Retailer Produce Working Group (EUREP) started as an initiative by retailers in 1997. The current version of the EUREPGAP document and procedures has been agreed among partners in the entire food chain for fruits and vegetables after wide consultation over three years. More than 700 people from more than 35 countries world-wide attended the annual EUREPGAP conferences in 1999, 2000 and 2001. Technical input from certification bodies concerned with compliance criteria combined with practical experience from field trials in more than one country were used to shape EUREPGAP. During this process, all developmental versions were made public on the EUREP website.

The normative document for certification, “EUREPGAP Fruit and Vegetables”, has been developed from a European group of representatives involved in all stages of the fruit and vegetable sector with support from producer organisations outside the European Community.

The EHI-EuroHandelsinstitut e.V., a non-profit making, private research and education institute in Cologne, Germany, acted as international secretariat in the construction phase of EUREP until February 2001. From March 2001, EHI founded the independent daughter company FOODPLUS GmbH that acts as independent global body, hosts the EUREP Secretariat and serves as legal owner of the normative document. EHI’s non-profit status is guaranteed by the Steering Committee that oversees the budget.

In January 2001, all retailer and supplier members of EUREPGAP set-up a formalised, representative decision making structure. A “Steering Committee” and a “Technical and Standard Committee Fruit and Vegetable” were created and given the responsibility for continuously reviewing documents and procedures.

RESULTS

Today, there are local offices of certification bodies in more than 25 countries world-wide. The first group of certifiers achieved internationally-accepted accreditation to ISO Guide 65/EN 45011, based on compliance criteria contained in “EUREPGAP Fruit and Vegetables”.

The prospect for growth of EUREPGAP by providing an international verification framework for a wide range of agricultural production sectors is, by any estimation, quite outstanding. EUREPGAP is considered to be in the pole position to become the global player in agricultural production standards and verification framework for fruit and vegetables. Retailers are resourcing globally and are facing increasing competition, there is pressure on profitability and an ever-tightening regulatory environment. Food safety has lately become a top priority

for many retailers. At the same time, producer organisations from all continents have applied to EUREPGAP for membership as they seek integrated and cost effective solutions for delivering assurance on food safety and environmental issues.

FOODPLUS/EUREPGAP is faced with the exciting opportunity of developing a global integrity and harmonisation programme, a task that can only be successful with a strong and harmonised support of a European and ultimately a global accreditation system.

METHYL BROMIDE

“The EUREPGAP protocol Fruit and Vegetables” provides transparency on the compliance criteria for methyl bromide (MB) whose use must be justified and recorded. Any partner in the food chain can demand information on whether MB has been used or not and take this into consideration in the purchasing decision. The independent certification assures the information. Via this transparency, EUREPGAP intends to discourage the use of MB in a voluntary way. The recommendations are recorded by an independent certifier. Note that “Recommendations” are currently voluntary but may become compulsory in the future.

Excerpt from Protocol Version September 2001:

Requirement	Recommendation
5.d. Soil Fumigation:	
#1 Chemical fumigation of soils must be justified.	#2. Alternatives such as crop rotation, planting of break crops, use of disease resistant cultivars, solarization, conversion to soil-free cultivation, and similar techniques must be explored before resorting to use of chemical fumigants

Excerpt from Control Points and Compliance Criteria Version September 2001:

Requirement	Compliance Criteria
5.d. Soil Fumigation:	
#1 Is there a written justification for the use of soil fumigants?	There is written evidence for the use of soil fumigants including location, date, active ingredient, doses, method of application and operator.

Recommendation	Compliance Criteria
5.d. Soil Fumigation:	
#2 Have alternatives to chemical fumigation been explored before resorting to use of chemical fumigants.	The grower should be able to demonstrate assessment of alternatives to soil fumigation through technical knowledge, written evidence or accepted local practice.

Recommendation	Compliance Criteria
13 Environmental Issues – impact on farming environment	
#1.1 Does the grower understand and assess the impact his farming activities have on the environment?	The grower is able to demonstrate his knowledge and competence in regard to minimising the potential negative impact of the farm activity on the local environment.
#1.2 Has the grower considered how he can enhance the environment for the benefit of the local community and flora and fauna?	There are tangible actions and initiatives that can be demonstrated by the grower either on farm or by participation in a group that is active in environmental support schemes.

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More information on the EUREPGAP programme can be obtained on the website www.eurep.org.

COMMERCIAL POLICIES IN SPAIN INFLUENCING THE USE OF METHYL BROMIDE BY GROWERS

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ABSTRACT

The Association of Harvesters and Exporters of Fruit and Vegetables in Almería (COEXPHAL) has had 25 years of experience in intensive horticulture in the south-eastern part of Spain. Eighty per cent of both producers and exporters in Almería are represented by COEXPHAL. Almería is the area with the highest percentage (70%) of production and export of vegetables in Spain. Growers since 1997 have been requested not to use methyl bromide (MB) and today MB is no longer necessary for production. Alternatives have replaced MB based on a new agreement on the appropriate measures to be taken reached jointly by COEXPHAL and different chains of supermarkets. Growers must fulfil specific requirements and comply with rules in order to be certified.

Keywords: vegetables, Almería, rules, greenhouses

INTRODUCTION

According to the Ministerio de Agricultura, Pesca y Alimentación (MAPA), methyl bromide (MB) was used to disinfect 1429 hectares in Almería in 1995. Although we are aware of the difficulty finding alternatives to MB to control pathogens, especially in certain places such as Huelva where strawberries are grown, we committed ourselves to the elimination of MB. All the requirements requested by the chains of supermarkets consisting of a programme for integrated production and a new agreement on the appropriate measures to be taken resulted in our efforts being directed toward the achievement of two goals: 1) A healthy product and 2) Grown with respect to the environment. In 1997, COEXPHAL with the “Federación Española de Productores y Exportadores de Frutas y Hortalizas-Spanish Federation of growers and Exporters of Fruit and Vegetables” (FEPEX) and the “Asociación Española de Normalización y Certificación” (AENOR, Spanish Association of Normalisation and Certification) were the driving force behind the creation of a norm of production (UNE 155001).

Since 1997, exporters have been requested not to use MB and it has been successfully replaced by new alternatives which has proved to be to our customers' complete satisfaction. Today, MB is no longer used in this area. Alternatives to control nematodes and pathogens were selected on the basis of successful research (e.g. Bello and Tello 1998). This paper describes rules that we have put in place to meet the requirements of the consumer and the environment. Finally, we discuss the success that we have had with specific alternatives to MB.

CONTROLLED PRODUCTION

Today, the international market requires high quality food produced with strict safety measures without damage to the environment. Norm UNE 155001 applies to growers who are bound to produce and handle fresh vegetables. Thus, growers are directly influenced by commercial policies in Spain. Growers must dismiss the idea of using MB as soon as possible and learn how to implement alternatives.

The consumer of food and agriculture products has become increasingly demanding, so several factors usually have a bearing on the final decision – according to the law of supply and demand. To comply with the consumer's demands, the consumer must be provided with the necessary information, and an attractively presented product that represents excellent value for money. The product must be delivered with speed and a guarantee is offered by the distributor. Of great importance to the consumer is how to care for body, health and their environment. Those factors result in the distribution becoming more and more important. In order to sell on the international market, excellent quality must be guaranteed as well as strict safety measures and commitment to the environment.

Up until a few years ago growers used to think that a good quality product was that meeting present-day demands for colour, flavour, size, weight, homogeneity. Currently, three basic requirements have been added to this list to fulfil the customer's demands:

- Products with no chemical residues;
- Vegetables produced with no detrimental impact on the environment; and
- Vegetables produced with the health and safety of the growers in mind.

The main objective of UNE 155001 is to meet these three requirements, so using MB makes no sense anymore. This controlling certified system has some advantages for the whole society, such as:

For the producers, because a reduction in the inputs will mean a measure to encourage saving in exploitation and its management based on a better quality of growing by means of a superior professional training for growers.

For consumers, excellent quality guaranteed thanks to the reduction of the phytosanitary residues and the control of the whole production process.

For society, by contributing to the social welfare. Chemical inputs are reduced and the company is bound to control and try to get the disposal of solid waste in order not to adversely affect the environment.

The Committee of Normalisation is made up by those responsible for drawing up the norm UNE 155001 (all the organizations and institutions representing both producers and exporters in Almería). They are representatives of MAPA, the Ministry of Economy, Department of Health, Consumption and the self-governments in Andalucía, Canarias, Cataluña, Extremadura, Murcia and Valencia. Institutions representing the national and provincial production are FEPEX, CCAE and some agrarian organizations such as ASAJA, COAG, UPA as well as some associations of producers and exporters from the main exporting areas. Some others are also taking part of it, such as laboratories, EUREP and AENOR.

COEXPHAL has been advising the production companies and they have been requested not to use MB since 1997. UNE 155001 is in complete control of this situation and, in order not to make any mistakes, this norm is revised and checked once a month by an accredited institution, AENOR.

If in the course of any of its investigations it is discovered that a grower has used MB, the whole company will lose its certificate in compliance with UNE 155001. This will help to achieve compliance with the proposed goals, not only because growers feel duty-bound to goals but also because the growers truly believe this is the best thing to do.

ALTERNATIVES TO METHYL BROMIDE IN INTENSIVE HORTICULTURE IN ALMERÍA

According to the National Project, they are alternatives to the conventional use of the MB which are respectful of the environment, economical and viable. This project is being directed by MAPA within the framework of the national programme for development and research. Its results are really positive (Bolívar 1999).

The most used technique to disinfect grounds in intensive horticulture in this south-eastern part of the country is solarization (physical disinfection) or solarization combined with a chemical product (mixed disinfection). Solarization is a very effective method to disinfect the grounds in the greenhouses in Almería. Solarization effectiveness depends on the weather and the time of exposure. Almería the perfect for solarisation as soil temperatures in summer can reach 70°C for 30 or 45 days. Solarisation is cost-effective and safe for people, animals and the environment. There are no chemical residues and it does not affect the physico-chemical properties of the ground. Yield increases after solarization probably due to pathogen control in the sandy soils.

Solarization combined with chemical products such as metam sodium in very small doses (100cc/m²) appears to be better for controlling mobile organisms like nematodes that can move to deeper areas before later returning to the soil surface. Metam sodium is a nematicide, fungicide, herbicide and insecticide. Mixed disinfection is often used successfully in Almería. In addition to metam sodium, polyvalent phytomedicine fumigant for salty grounds has also proven successful. Where it is important to control mainly problems with nematodes,

dicloropropene (1,3-D) is often used in drip irrigation together with the solarization with 80% success.

According to this growing system, the land is mostly made (“enarenado”) of sand (90%) which is enriched with organic matter every two years. Nearly all varieties of organic matter can be used as a biofumigant, although its effectiveness depends on the dose and the way it is handled. Greenhouses in Almería have been making use of this technique – sand and dung, a wonderful biofumigant – for over 40 years, and it has always been preferred to MB.

Some greenhouses have had to try different methods to fight against some diseases such as *Fusarium* disease in watermelon. Growers found the solution to be grafted plants that consisted of a watermelon (sensitive to *Fusarium*) grown with a pumpkin root (resistant to *Fusarium*) (Bello *et al.* 1997, 1998). Grafted plants were safer for growers, less costly and more productive than MB.

CONCLUSIONS

Growers in Almería are responsible, dynamic professionals keen to learn new technological and agronomic improvements that could be included in their greenhouses. The successful adoption of alternatives to MB in Almería, based on the efforts of growers in this region, could be considered as a model for growers in other regions of Spain.

It is interesting to note that nowadays, one of the most important things to be protected is the ozone layer. Eliminating MB would mean avoiding millions of cancer skin cancers and eye cataracts. Our environment has to be protected from anything dangerous or harmful.

We will do our best and we publicly declare our support to the proposal that MB be eliminated. We want to produce – and we do produce indeed, fresh vegetables guaranteeing the healthiness of the products as well as the respect for the environment. Thus, we think that all the alternatives that different researchers often give us should be carried out because they are proving to be really useful, depending on the growing system. The most important aspect seems to be spreading the information and training growers in how to use the alternatives.

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UNIDO PHASE – OUT PROGRAMME IN THE METHYL BROMIDE SECTOR

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INTRODUCTION

UNIDO as one of the implementing agencies under the Multilateral Fund has been engaged in the phase-out of methyl bromide (MB) in developing countries.

In the first phase, 22 demonstration projects have been implemented taking into account both climatic and social conditions in developing countries. More than 10 alternatives have been tested for their usefulness as both soil fumigants and for the treatment of commodities. The most suitable alternatives to MB have been selected by local farmers and other stakeholders in order to initiate phase-out programmes in more than 50 countries. Partial phase-out of MB has already taken place in certain developing countries thanks to the financial assistance provided by the Montreal Protocol's Multilateral fund.

In September 1997, Parties to the Montreal Protocol agreed a phase-out schedule for MB in developing countries, starting with a freeze in consumption in 2002. After a series of demonstration projects mainly conducted by UNIDO, the quick and enthusiastic response came from many developing countries requesting an earlier phase-out of MB. Indeed it is expected that in large and medium MB-consuming countries, a total phase-out (except essential uses) could be within reach in 2006, well in advance of the agreed phase out date of 2015 under the Montreal Protocol for developing countries. Advancement of the phase out date is mainly due to three major reasons:

- Alternatives are available and have proven effective in developing countries;
- Developing countries want to catch up with developed countries in terms of new technologies;
- Developing countries want to ensure continuity of exports to developed countries who may not accept products treated with MB after the deadline of 2005.

THE PHASE-OUT PROGRAMME OF UNIDO

UNIDO has implemented and completed 22 demonstration projects. The projects have involved various categories of alternatives (Table 1).

Table 1: Categories and types of alternatives to methyl bromide tested by UNIDO.

CATEGORY OF ALTERNATIVE	TYPE
Physical:	Solarization Steam pasteurization Floating trays Grafting Crop rotation
Chemical	Metam-sodium 1,3 D (telone) Phosphine Basamid Biofumigation
Biological alternatives	Biocontrol agents

ALTERNATIVES SELECTED AND LESSONS LEARNED

- Number of phase-out projects so far : 17
- Number of countries : 15
- Total ODP phase-out : 2,515 tonnes
- Total budget approved : US \$ 24.8 million

PREPARATION OF NEW PROJECTS

- Number of phase-out projects in preparation for 2002: 10
- Number of countries: 10
- Total ODP phase-out expected: 500 ODP tones
- Total budget estimated: US\$ 4.1 million

SPANISH NATIONAL PROJECT TO FIND ALTERNATIVES TO METHYL BROMIDE THE REMAINING CHALLENGES

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SUMMARY

The Spanish national project to find alternatives to methyl bromide (MB) was launched in 1997 with the short-term objective of finding alternatives to compensate for the reduction and ultimate cessation of the use of MB. Results achieved so far have overcome some of the fears expressed by the producers of strawberries and peppers under glass who are the main users of the product. Nonetheless, there are underlying problems which require further research in the near future targeted at ensuring the viability of these and other crops while also ensuring the utmost respect for the environment and sustainable agriculture.

Keywords: alternatives, ban, environment, viability, integrated production, methyl bromide

INTRODUCTION

Production areas in Spain

Andalusia, chiefly the province of Huelva, is Europe's main strawberry-producing region and one of the largest strawberry production areas in the world consisting of around 8,000 hectares and more than 1,800 producers. Strawberry growing has contributed to the economic and social development of various districts in the province of Huelva, transforming what were formerly depressed areas whose populations were forced to emigrate in search of better prospects into areas that now attract immigration.

On the other hand, the nursery subsector, with 46-48 producers of strawberry plants, is located chiefly in the Castile-Leon region, with some 1,000 hectares and more than 15.5 million mother plants.

In another area in Andalusia, on the north-western coast of the province of Cadiz, there is a large area producing horticultural crops and ornamental plants, particularly cut-flowers. These sectors are mainly family-run farms who use MB occasionally for production.

In the south-east of Spain, in the Campo de Cartagena region, is an area of approximately 1,300 hectares of greenhouses dedicated primarily to the production of thick-walled peppers for export. These producers comprise small and medium-sized family concerns as well as large company-run farms. In most of these greenhouses, the use of MB to disinfect soil is a standard technique.

In the Valencia region, with its extensive vegetable production and high level of citrus fruit production, MB has occasionally been used. In addition, a small area of almost 300 hectares is dedicated to strawberry growing. Cultivation methods, soil characteristics and climate in this region are significantly different to those in the province of Huelva, making it valuable to include it in the test network of the national project in order to compare results.

The brief description given above of some of the producing areas explains the anxiety and concern felt in the main producing sectors in 1995 that were dependent on the use of MB and were facing the prospect of the phasing out MB which the Vienna Conference (the Seventh Meeting of the Parties to the Montreal Protocol) had set as 1 January 2010. These fears were subsequently confirmed when the date for the definitive ban on MB was brought forward by the Parties to the Montreal Protocol to 1 January 2005 internationally for developed countries including the European Union. In these circumstances, at the beginning of 1997, the Ministry of Agriculture, Fisheries and Food and representatives of producers of strawberries and peppers under glass asked the National Institute of Food and Agricultural Research and Technology (INIA) to launch a research project to find viable alternatives to MB in the short term.

THE PROJECT

In March 1997, INIA brought together an eminent group of experts and gave them the task of drawing up a research project to find alternatives to MB in the short term which would be economically viable, environmentally-friendly and would maintain production volume and quality levels, in order to prevent economic and social progress being undermined for broad swathes of the agricultural population. The basic task was to launch a project combining research, testing and development, enabling the results obtained to be transferred directly to the producing sectors. It would have to be an essentially field-based operation involving the growers' own farms, in which the experimental plots would be designed large enough to apply the current techniques and equipment used by farmers. The project would also have to be dynamic in nature, so as to enable new hypotheses to be brought on board. These are distinctive characteristics distinguishing it from other ongoing research projects.

Researchers and their home research institutions responded enthusiastically to INIA's assignment, and this national project was developed and put into practice in four Autonomous Communities (Andalusia, Murcia, Valencia and Castile-Leon), with the participation of 10 research centres belonging to the Autonomous Communities of Andalusia, Murcia and Valencia, the Scientific Research Council (Consejo Superior de Investigaciones Científicas) and INIA, and the participation of academics from the universities of Almería, Huelva and the Universidad Politécnica de Valencia. I must also mention the valuable cooperation given by the associations Freshuelva, Asociación de Viveristas de Fresa, FECOAM (agricultural cooperative federation of Murcia), VALSUR de Valencia and the farmers who made their own farms or those of their partners, and their technical experts, available to the project.

The project studied various hypotheses, some based on chemical soil treatment, others on physical soil processing, or a combination of these. The project was designed to run for five years. As regards strawberry production, the fifth year of the project in 2002 has mainly been devoted to establishing demonstration fields to transfer to the production sector the MB alternatives which proved most viable in previous years. For the other crops, tests have continued as in previous years.

I must mention one factor - not, in this case, a scientific aspect - which was vital to the successful completion of the project and that is the funding provided, with exemplary coordination of efforts, by three Ministries: Agriculture, the Environment, and Science and Technology.

RESULTS

Over the last few days we have had the opportunity to hear the various members of the research team present the work they have carried out and the results they have obtained and so I shall summarise the results strictly in terms of cutting down on the use of MB and doing away with it completely in the near future.

Implementing some of the techniques tested has proved to be a trouble-free solution to achieving the successive cuts in levels of MB use laid down in Regulation EC2037/00 of the European Parliament and of the Council of 29 June 2000 for the cultivation of peppers under glass and strawberries. Some of the techniques tested suggest that discontinuing the use of MB should not cause serious immediate problems in these two crops, which have great economic and social impact in the areas where they are grown. Similar results are reported for other horticultural crops.

The techniques tested in strawberry plant nurseries and in cut flower production have not so far provided very good alternatives to MB. The following points should be made with regard to these two areas:

- It is essential that nursery plants are guaranteed optimum standards of health since they provide the basis for fruit production;
- Solutions such as the use of steam in cut-flower production may continue to be beyond the means of small producers because of the high costs involved and, what is more, the

success of this technique depends to a great extent on the type of soil to which the steam is applied.

THE REMAINING CHALLENGES

Further research into alternatives must be undertaken for the last two cases mentioned, strawberry-plant nurseries and cut-flower production. Techniques for the application of the MB alternatives found for strawberry and pepper crops grown in greenhouses must be refined in order to minimise the impact on the environment.

There is also uncertainty as to how, over coming years, the fauna and flora of soils that have for decades been treated with MB will develop when MB finally ceases to be applied and is replaced by alternative methods. We must continue to monitor the situation closely. In particular, virulent strains of nematodes may develop which are hard to control with other nematocides.

Alternatives to MB must be found for problems such as soil fatigue, which is an acknowledged problem for tree crops but hardly ever accepted as existing with arable crops even though we have grounds to believe it does exist.

Debates on the future of agriculture focus on integrated production, an attempt to exploit natural resources to the full in order to sustain and protect crops while minimising the impact of agrochemicals. However, saying is one thing and doing another. Although there has certainly been a great deal of discussion about integrated production, there has been little research into making it socially viable. The competitiveness of integrated production is based on the higher prices that certain social groups, generally with a high level of purchasing power, are prepared to pay for its products, entailing clear discrimination against other, less well-off sectors.

While it is clear that we have to safeguard the environment for the benefit of future generations, it is no less clear that we face the problem of a growing world population, whose essential nutritional needs - and the equally essential need for reasonable standards of welfare - must be satisfied. This is one of the main challenges which research must tackle, for both aspects, supporting the human population and protecting the environment, are key to the concept of sustainable agriculture.

Logically, before turning to matters of production and contamination, there are controversial philosophical, and sometimes dogmatic, questions that arise if we do not consider the many aspects and social and economic implications of the matter. This is another area where multidisciplinary research, free of preconceptions, has a great deal to do in making a balanced assessment of the situation.

In conclusion, these are some of the remaining challenges posed not just by the ban on MB but by the need to ensure continued life on earth. Our work cannot be considered to be over. Instead, we must remain alert to any possibility which may arise which may feed into research, constantly bearing in mind the imperative to safeguard the environment and provide support to our neighbours throughout the world.