PART 1 CONTEXT AND SCOPE

The scope of this report

1. Government[1] is developing its policy on the possible commercial growing of genetically modified (GM) crops in the UK. New European legislation which should end the *de facto* moratorium in the EU on approving new GM crops and foods is now in place. The Agriculture and Environment Biotechnology Commission (AEBC) has considered the key issues of coexistence and liability raised by the possible commercial production of GM crops. In doing so, we should point out that we have not assumed that commercial growing will inevitably go ahead.

2. We have in particular looked at whether it would be practicable for the commercial production of GM crops to coexist with existing conventional[2] and organic systems of agricultural production in a way that secures continuing real choice to consumers. Could practicable measures be devised and implemented to ensure that different sorts of farming can coexist, with domestic agriculture continuing to offer consumers the present choice of conventional and organic products alongside GM products? Could and should arrangements be made to compensate farmers who might suffer economic loss if and when coexistence measures did not work? Who if anyone could or should be held liable for any such loss?

3. We have considered the equally important issue of what would happen if the commercial production of GM crops turned out to have a damaging impact on the environment. Who would be held liable for putting any damage right, and how? And who would take responsibility in the event of any environmental damage judged to be irreversible? The issue of whether measures to deal with coexistence and liability might lead to loss of opportunities of possible benefit to agriculture and the environment from growing GM crops has also regularly been raised in our discussions.

4. We begin with the context for consideration of coexistence and liability issues: present trends in public attitudes and UK agriculture policy; and the present regulatory framework for GM crops.

Public attitudes

5. The context in which we (and others) have been considering these issues is highly charged and marked by profound disagreements amongst interested parties and society as a whole. These disagreements encompass views about the novelty, speed of development, and transformative potentials of GM technology and the uncertainties over what its use may bring; the turbulent politics of GM, including now formal action by the United States Government in the World Trade Organisation against the European Union; and the present climate of UK public opinion.

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[1] "Government" here and elsewhere in this report means the UK Government, the Scottish Executive, the Welsh Assembly Government and the administration in Northern Ireland.

[2] In this report, we use the term "conventional" or "non-GM" agriculture to mean farming which does not use GM crops but which is not organic agriculture. We consider organic agriculture separately because of the particular issues it raises in relation to use of GMOs.

6. Reflected in this report are some sharp differences of view among us, as well as some common ground, about aspects of coexistence and liability. AEBC members bring some shared but some different values to bear on the issues; and we do not always arrive at the same result when weighing up the options. This should not be surprising. As the Prime Minister's Strategy Unit (PMSU) noted in their recent analysis of possible scenarios for GM crops in the UK, value judgements and weighting of different factors are required in any assessment of how possible costs and benefits from GM crops should be traded off against one another[3].

7. The latter development of this report has taken place against the background in summer 2003 of *GM Nation?*, a nationwide programme of debate on GM[4]. The survey of existing research into public attitudes to GM issues, conducted in autumn 2002 prior to the period of the debate, indicated among other things that:

> "…Against a background of relatively positive attitudes to science and also to many non-food applications of biotechnology, attitudes to GM food/crops have been largely negative over the last decade. Attitudes are also characterised by ambivalence and uncertainty, largely due to low levels of information and a sense of distrust in the relevant institutions."[5]

8. The substance and tenor of this research was reflected in the PMSU's[6] analysis that public attitudes will be important in determining the future of GM crops and foods in the UK. Their analysis drew on recent opinion poll surveys, which have generally indicated a negative public attitude towards GM food and crops, although with some evidence of ambivalence, and of differentiation between: GM food and GM crops; food, feed and non-food applications of GM; and different GM traits. This was reflected in key messages from the final report from *GM Nation?* which - although not designed as a quantitative opinion poll survey - found that there was a general uneasiness about GM crops and little support for their early commercialisation[7].

9. It seems clear that issues of choice, coexistence, and environmental impacts lie at the heart of much of the public debate in the UK; and that many people are at the very least cautious, for various reasons, about the prospect of growing GM crops on a wide scale. The AEBC is charged particularly with taking into account public attitudes in our considerations in addition to the economic, scientific, legal and international context of developments in relation to GM crops. As noted earlier, this report looks at issues raised by the prospect of GM crop commercialisation in the UK. We all recognise that some people do not want commercial growing to happen in any circumstances. What we have aimed to do is to develop our advice about coexistence and liability, were GM crops to be grown commercially, taking fully into account the present state of public opinion as we see it, while recognising that there

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[3] PMSU report, p.101

[4] See http://www.gmnation.org.uk for the report of the debate (published September 2003).

[5] *Public Attitudes to the Commercialisation of GM Crops: A Report on Desk Research*, John Kelly, December 2002.

[6] Part 2 of the PMSU report, p.29

[7] The G*M Nation?* programme of debate elicited some 37,000 individual responses from people attending around 600 meetings of various kinds around the UK, or visiting the website or otherwise sending in their views. In addition to the 'open' programme of deliberative debate, a series of reconvened 'narrow but deep' discussion workshops took place in parallel in June/July 2003, were held with invited participants who had not before been actively involved in activities for or against GM. Reports of these different activities, the overall report of the debate, and the initial desk research on public attitudes conducted in autumn 2002 may all be viewed at http://www.gmnation.org.uk

is a spectrum of opinion, and allowing for the possibility that public attitudes might change in the future. Freedom for consumers to choose the products they want, whether from conventional, organic or potentially GM agriculture, and concern that such choices might become unavailable, has to be examined in this context. We have approached the question of coexistence of GM and other crops with the issue of consumer choice at the centre of our considerations[8].

10. It should also be kept in mind that agricultural production in the UK is directed not only to local markets but, particularly in the case of commodity crops, also to foreign markets. We understand for instance that an export market has been established for industrial grades of UK oilseed rape and for specific grades of wheat, and a market for linseed is developing. UK farmers will be responding to these markets as well as to the domestic consumer market.

Agricultural policy in the UK and the EU

11. The Policy Commission on the Future of Farming and Food, which reported in January 2002 (the Curry Report)[9], suggested a clear direction for the future of agriculture in England. The report emphasised that farming should reconnect with its markets by responding more appropriately to demand. Because of its inherently higher cost base, the UK cannot generally expect to be competitive in global commodity markets, so it should concentrate on higher quality, higher value-added products in which the UK would find it easier to be competitive[10].

12. However, the report was clear that there was no "one size fits all" solution to the immense challenges facing the industry. While some farmers should benefit from the opportunities presented by an increasing consumer interest in the provenance and quality of food, some would survive by utilising their assets such as land and buildings in more creative ways. There might also be opportunities in non-food crops (for example, biofuels). The devolved administrations carried out their own reviews at approximately the same time, making recommendations with a similar thrust[11].

13. In its strategic response to the Curry Report[12], the UK Government acknowledged that the challenge for the farming industry as a whole was to be flexible, entrepreneurial and close to its markets, suppliers and customers. The Government's overarching aim was to "promote a competitive and efficient farming

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[8] English Nature, in evidence to us (May 2003, following our coexistence stakeholder seminar), argued in addition that environmental factors can be closely related to coexistence measures. There could be biosafety reasons for restricting gene flow, to prevent some instances of gene-stacking in crop or wild plants. Or, for example, greater spraying of conservation headlands to deal with volunteers, as part of coexistence measures, could have an environmental impact. Environmental effects as well as economic impacts need to be considered in developing coexistence measures.

[9] *Farming and Food – a sustainable future.* Report of the Policy Commission on the future of farming & food. January 2002. Chair – Sir Donald Curry. http://www.cabinet-office.gov.uk/farming .

[10] The PMSU report assessed that wider developments in agriculture are likely to be more important to UK agriculture in the short term than GM crops. National and EU policy decisions relating to the (subsidised) market in agricultural produce will have a much greater impact on farmers' incomes.

[11] *Forward Strategy for Scottish Agriculture*, June 2001, which can be viewed at http://www.scotland.gov.uk/library3/agri/fssa.pdf. Similar themes are picked up by the Steering Group set up to develop a vision for the future of the agri-food industry in Northern Ireland, which reported in October 2001, http://www.dardni.gov.uk/publications/pubs0036.htm and in 'Farming for the Future', the Welsh Assembly Government's strategy, http://www.wales.gov.uk/subiagriculture/content/futures/futuresgroup_e.htm

[12] Defra, *The Strategy for Sustainable Farming and Food* for England, incorporating a response to the recommendations of the Curry report. October 2002. http://www.defra.gov.uk/farming/sustain/response

and food sector which protects and enhances our countryside and wider environment, and contributes to the health and prosperity of all our communities". It saw the liberalisation of agricultural trade and the removal of trade-distorting support and protection mechanisms as a driver not only for allowing producers to reconnect with their markets but also for improved environmental standards. The devolved administrations have embarked on action plans to implement their respective strategies for agriculture, with similar themes, taking account of the specific patterns of agriculture in each territory.

14. There has also been a fundamental shift in agricultural policy, both within the EU and the UK, towards environmental protection and enhancement. It has been recognised that the Common Agricultural Policy (CAP) system of production subsidies has led to considerable environmental harm, and has distorted market signals from the consumer to the farmer. UK agriculture was tremendously successful in delivering the huge improvements in efficiency and volume of production asked of it by Government and society following the second world war. However, external costs, for example loss of biodiversity; the devaluation of environmental capital, such as soil quality and quantity, and the more easily calculated costs of, for instance, removing pesticides from water supplies, historically have not often been taken into account in analysing farming's technical and economic successes.

15. A key aim of the reforms of the CAP agreed by European Union agriculture ministers on 26 June 2003[13] is to remove environmentally negative incentives in the current policy and provide further encouragement for more sustainable farming practices. This involves "decoupling" financial support from production: breaking the link between what a farmer produces and the subsidies he or she receives for the vast majority of arable and livestock production. Instead a new 'single farm payment' to the farmer will be conditional on meeting environmental, food safety and animal welfare standards as well as the requirement to keep all farmland in good condition ("cross-compliance"). The different elements of the reform will enter into force in 2004 and 2005. The single farm payment will enter into force in 2005[14].

Policy on GM crops

EU legislation[15]

16. The cultivation of GM crops and their import as commodities has been regulated at EU level since 1990. The relevant legislation for granting permission to sell a new GM crop is now the Deliberate Release Directive 2001[16]. Part C of the Directive

[13] Decision at the EU Council on Agriculture, Luxembourg, 26 June 2003.

[14] Although Member States have the option to continue linking subsidy to production until 2007, an option France is expected to exercise.

[15] For more details, see Annex A.

[16] Directive 2001/18/EC of the European Parliament and of the Council of 12 March 2001 on the deliberate release into the environment of genetically modified organisms and repealing Council Directive 90/220/EC (OJ L106, 17 April 2001). This Directive came into force on 17 October 2002. It replaces the previous Deliberate Release Directive (Council Directive 90/220/EEC of 23 April 1990 on the deliberate release into the environment of genetically modified organisms (OJ L117, 8 May 1990) as amended by Commission Directives 94/15/EC of 15 April 1994 (OJ L103, 22 April 1994) and 97/35/EC of 18 June 1997 (OJ L169, 27 June 1997)). In Scotland, 'The Genetically Modified Organisms (Deliberate Release) (Scotland) Regulations 2002, SSI 2002 No. 541'. In Wales, 'The Genetically Modified Organisms (Deliberate Release) (Wales) Regulations 2002, No. 3188 (W304). In

provides that approval for commercial cultivation can be refused only on grounds of risks to human health or environmental safety. Once a GM variety has received "Part C" approval, it is authorised for use throughout the EU, in line with European single market principles, and in general no individual Member State may prohibit, restrict or impede its use[17]. By 1998, three types of GM maize had already been approved for commercial cultivation[18]. Since then there has been a *de facto* moratorium on the issuing of new consents, as a number of Member States have made it clear that they would oppose them. However, this moratorium has no legal basis, and the US Government in the World Trade Organisation has now formally challenged it.

17. EU legislation currently requires products to be labelled as containing GMOs if they have a GM content of 1% or more. Legislation[19] has now been passed to reduce that threshold to 0.9%, and to extend it to all products produced from GMOs, even if no DNA or protein of GM origin is detectable in the final product (e.g. refined soya, maize and oilseed rape oils).

18. A legal basis for Member States to take national measures to ensure that the production of organic and conventional crops can coexist with GM crops was introduced during the passage of the new GM food and feed and traceability and labelling legislation. "Member States may take appropriate measures to avoid the unintended presence of GMOs in other products."[20] The measures must be consistent with the principles of the single European market. This legal provision has taken the form of an amendment to EC/2001/18[21]. Member States may decide to use either existing or new national legislation to put regulation in place at the national level.

19. There are also proposals to establish legally enforceable standards for GM content in seed described as non-GM. The thresholds under discussion in the European Union are designed to make it possible to keep the final crop below the threshold (0.9%) at which labelling is required[22].

Northern Ireland, 'The Genetically Modified Organisms (Deliberate Release) Regulations (Northern Ireland) 2003, No. 167.

[17] Although Article 23 of the Deliberate Release Directive provides that a Member State may provisionally restrict the use and/or sale of a product on its territory where justifiable reasons to consider that the product constitutes a risk to human health or the environment have arisen since the grant of its Part C approval.

[18] In addition, a number of crops had received approval for import as commodities; this aspect falls outside the scope of the present report.

[19] Regulation (EC) No 1829/2003 of the European Parliament and of the Council of 22 September 2003 on genetically modified food and feed; and Regulation (EC) No 1830/2003 of the European Parliament and of the Council of 22 September 2003 concerning traceability and labelling of genetically modified organisms and traceability of food and feed products produced from genetically modified organisms and amending Directive 2001/18/EC. The food and feed regulation entered force on 7 November 2003 and applies from 18 April 2004. The labelling and traceability regulation also entered force on 7 November 2003 and will apply 90 days from publication of a system for development and assignment of unique identifiers for GMOs.

[20] Article 44(2) of Regulation (EC) No 1829/2003 (Food and Feed Regulation).

[21] This change to EC/2001/18 will not require changes to existing national legislation transposing the Directive because the amendment does not impose new duties but rather gives permission to introduce new arrangements on coexistence, at Member State level.

[22] The EU Standing Committee on Seeds discussed these proposals on 22 September 2003. France asked the European Commission to seek specific confirmation from the Scientific Committee on Plants (SCP) that the proposed thresholds would enable the 0.9% threshold for food and feed to be met. The SCP's earlier advice was clear that the proposed thresholds for seeds remained feasible even with the reduction in the food and feed threshold from 1% to 0.9% (see Table 1 on page 8 of the SCP opinion dated 13 March 2001). However, the Commission acknowledged that the SCP's opinion had been delivered before agreement had been reached on the 0.9% threshold and so it agreed the French proposal. The timetable is uncertain but a final vote in the

20. Legal provisions already exist prohibiting the use of GMOs in organic production (though not at present setting any special limit for the adventitious presence of GM material in organic produce and as such, in the absence of ratified standards, the proposals set for presence in non-GM foods would apply for the purposes of labelling).

Policy responsibility for GM matters in the UK

21. There are four Competent Authorities in the UK (one each for England, Scotland, Wales and Northern Ireland) for the purpose of consents for release and marketing of GMOs under the Deliberate Release Directive. For authorisations, all Competent Authorities will rely on the expert committees of ACRE[23] and ACNFP[24] for advice, but the questions asked of these bodies and the conclusions to be drawn from the advice will be for the Competent Authorities and relevant Ministers to assess. It follows that when Defra is acting on behalf of the UK as a whole (as the Member State of the EU), it must seek agreement from the other three Competent Authorities.

22. The policies of the devolved administrations in Scotland and Wales on GM crops are to varying degrees different from the stated policy of the UK Government, which is that it is neither for nor against GM crops.[25]

23. The Scottish Government has stated that: "We will rigorously apply the precautionary principle in our approach to the planting of GM crops. We will assess the results of the GM farm scale trials ensuring that there are opportunities for peer review and assessment by others including environmental organisations. Until this process is concluded, we will not permit further GM trials or commercial growing of GM crops"[26].

24. The Welsh Assembly Government has a policy of operating the most restrictive policy possible within the context of existing EU legislation on future GM crop development within Wales. During the Farm Scale Evaluations (FSEs), the National Assembly for Wales issued a prohibition notice under section 110 of the Environmental Protection Act 1990, to place a legal obligation on growers of T25 GM Maize to ensure that separation distances are observed between GM and non-GM crops. This prohibition notice was communicated to the European Commission via the UK Government through the Article 16 procedure under Directive 90/220/EEC[27]. Although the European Commission has questioned the legal basis for the UK action[28], it has not shared its legal advice with the UK. Until the Commission advises that the prohibition notice contravenes the Directive it remains in force. The administration in Wales has received no challenge from the seed producer Aventis (now Bayer), although we understand that the company has asked the administration on a number of occasions to justify the basis on which the action was taken.

25. Each devolved administration will now have freedom, if it so wishes, to introduce arrangements to ensure coexistence, as a devolved matter, including possibly

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Standing Committee on Seeds could take place from around the end of January 2004, with transposition by Member States of the Directive into national regulations taking place thereafter.

[23] Advisory Committee on Releases to the Environment .

[24] Advisory Committee on Novel Foods and Processes.

[25] The devolved institutions in Northern Ireland are currently suspended.

[26] Statement of 15 May 2003: http://www.scotland.gov.uk/library5/government/pfbs.pdf, p18.

[27] Now replaced by Article 23 of Directive 2001/18/EC.

[28] Letter Wallström to Beckett, April 2002.

regulation, following the introduction of legal authority through the coexistence amendment to 2001/18/EC. Moreover, the European Commission's draft guidelines on coexistence recommend that relevant regional differences are taken into account in developing coexistence measures. So different coexistence arrangements could in principle be put in place in Wales, Scotland, England and (possibly) Northern Ireland.[29]

The Farm Scale Evaluations in the UK

26. The UK has undertaken a programme of monitored plantings (the Farm Scale Evaluations: FSEs) covering winter and spring varieties of oilseed rape, beet (fodder and sugar) and forage maize[30]. In October 1998, the Government reached a voluntary agreement with SCIMAC[31] to delay large-scale commercial planting of GM crops for one year, while the FSEs were carried out. Following that initial year, the Government negotiated a new agreement with SCIMAC, announced in November 1999[32], which provided that the FSEs would be continued for the next three years, and there would be no "general unrestricted cultivation" of GM crops in the UK until they were complete[33].

27. The first set of results (for the spring-sown crops) was published in October 2003; those for winter-sown oilseed rape are expected to be published in 2004.

28. The Scientific Steering Committee overseeing the FSEs advised Ministers that:

> "Growing conventional beet and spring rape was better for many groups of wildlife than growing GM herbicide-tolerant (GMHT) beet and spring rape. Some insect groups, such as bees (in beet crops) and butterflies (in beet and spring rape), were recorded more frequently in and around the conventional crops because there were more weeds to provide food and cover. There were also more weed seeds in conventional beet and spring rape crops than in their GM counterparts. Such seeds are important in the diets of some animals, particularly some birds. However some groups of soil insects were found in greater numbers in GMHT beet and spring rape crops. In contrast, growing GMHT maize was better for many groups of wildlife than conventional maize. There were more weeds in and around the GMHT maize crops, more butterflies and bees around at certain times of the year, and more weed seeds."[34]

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[29] On the other hand, at time of writing, some Member States have called for EU-wide rules (rather than guidelines) on coexistence and stipulated this as a requirement for them to lift the informal moratorium on new approvals.

[30] The objective of the FSEs is to investigate whether the herbicide management associated with these GM crops, as compared with that used on the non-GM equivalents, has any effects on some aspects of farmland biodiversity – that is to say, on the number and diversity of plants and animals. For a detailed discussion of the FSEs, see our report *Crops on Trial*.

[31] The agreement with SCIMAC (the Supply Chain Initiative on Modified Agricultural Crops) was announced by Michael Meacher, Minister for the Environment, in his evidence to Sub-Committee D of the House of Lords Select Committee on the European Communities on 21 October 1998 (see HL Paper 11-II, 2nd Report Session 1998-99, Q 603).

[32] DETR News Release 507, "Voluntary Agreement on GM Crops Extended", 5 November 1999.

[33] The FSEs comprised a total annual average of around 400 hectares of GM crop cultivation. By way of comparison, about 700,000 hectares in total is grown annually of these conventional crops, of which around 1200 (0.2%) is organic.

[34] Scientific Steering Committee for the GM crop farm-scale evaluations: Final advice to Ministers 16th October 2003 (available on the Defra website: http://www.defra.gov.uk).

In addition:

> "The researchers stress that the differences they found do not arise because the crops have been genetically modified. They arise because these GM crops give farmers new options for weed control. That is they use different herbicides and apply them differently."[35]

29. The FSE results will now be considered by ACRE, who will advise Ministers on their implications. This advice is expected in December 2003 or January 2004. In the light of ACRE's advice, Ministers will decide the UK's position on whether these specific crops should be approved for commercial cultivation in the EU. The UK Government has also stated that in parallel it will also be reflecting on the findings of its GM dialogue - the public debate, the science review, and the costs and benefits study - and on this report, and that it will decide its overall policy on GM crops in the light of all the available evidence[36]. The Scottish and Welsh administrations are doing likewise.

The current position on commercial growing

30. The GM herbicide-tolerant maize transformation event (T25)[37] already has Part C approval. One variety of maize (Chardon) including T25 is at present being assessed for listing on the national seed list. The use of the associated herbicide with it under the pesticide regulations also remains to be approved. It is possible although unlikely that the regulatory process will be completed in time for farmers to plant the crop in spring 2004, subject to ACRE's advice on the FSE results for maize and no withdrawal of consent on the basis of the FSE results.

31. Large-scale commercial GM maize production in the UK in spring 2004 seems unlikely, however, regulatory considerations aside[38]. Market take-up will depend on a range of factors including the fact that even after a new crop becomes commercially available, it takes time to develop varieties suited to UK conditions; the tendency of any new crop technology to take-off fairly gradually (farmers like to see how suitable a new crop is for their farm, growing a limited amount themselves initially or noting the experiences of neighbours or demonstration farms); and because the UK consumer base is relatively weak.

32. The Deliberate Release Directive sets out deadlines for consideration of applications[39], and the Government seems likely to be obliged soon to give its

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[35] The implications of spring sown genetically modified herbicide tolerant crops for farmland biodiversity: a commentary on the Farm Scale Evaluations of Spring Sown crops. Firbank et al, October 2003. Conclusions - page 19. Available from Defra and on their website http://www.defra.gov.uk.

[36] Defra press release, 16 October 2003, *Farm Scale Evaluations – Important new evidence on GM crops*.

[37] The maize variety being used in the FSEs.

[38] Bayer CropScience was reported as stating on 29 September 2003 that "If the government says 'yes' to commercial GM crops, then GM maize would be he first to be planted, although it would be some time before we see GM rapeseed and sugar beet – maybe in 2006…It's possible that GM maize could be planted as early as next year, but this looks unlikely"; and that the quantities of GM maize planted would initially be relatively small. *Bayer says GM maize ready for planting in Britain*, Reuters Financial News, 29 September 2003 (http://www.reuters.com).

[39] Although the 'clock can stop' at different stages if and when a company is asked to provide further information in support of its application, so the total period of time taken to process an application is not fixed absolutely, and it remains possible in effect for Member States to continue (illegally) blocking individual approvals. It is not clear whether there will be any practical effect on operation of the approvals process as a result of the alteration in 2004 (effected by the new Food and Feed Regulations – see Annex A) to the approval mechanism, whereby the

opinion on some of the nineteen applications for Part C consent under the Directive which are currently awaiting decision. The early ones on which the UK will need to give an opinion or vote on applications, possibly by the end of 2003, are for import into the EU only rather than cultivation. Only six of these are for herbicide-tolerant GM crops which might be grown in the UK[40]. On these, the Government has commented that the UK will not be able to give its final view until it has assessed the final results of the FSEs[41].

33. Further information for Government decision-making has become available from the strands of the public "GM dialogue". The *GM Nation?* strand was discussed above. The two other strands of the GM dialogue, a review of science around GM, led by Professor Sir David King (the Government's Chief Scientific Adviser) working with Professor Howard Dalton (the Chief Scientific Adviser to the Secretary of State for the Environment, Food and Rural Affairs), with independent advice from the Food Standards Agency; and a study by the Prime Minister's Strategy Unit of the overall costs and benefits of GM crop commercialisation, considering a full range of possible scenarios for the future development of GM crops in the UK, including a "no GM" scenario, were both published in July 2003[42].

34. The Strategy Unit's central conclusions were that:

- existing GM crops could offer some cost and convenience advantages to UK farmers;
- however, any economic benefit to the UK is likely to be limited, at least in the short-term - only a narrow range of existing GM crops are currently suited to UK conditions, and weak consumer demand is likely to limit take-up;
- looking to the longer term, future developments in GM crops have the potential to offer more wide-ranging benefits, to farmers and to consumers - possibilities include GM crops with agronomic benefits more suited to the UK; GM crops delivering direct health benefits (e.g. delivering foods with reduced allergenicity or added nutrients); or non-food GM crops used as a source of pharmaceuticals and vaccines;
- however, the overall balance of future costs and benefits will depend on public attitudes, and on the ability of the regulatory system to manage uncertainties[43].

We draw on the analysis in the PMSU report throughout this report, and on the work of the Science Review Panel.

35. The Science Review Panel's first report[44] found no scientific case for ruling out all GM crops and their products, but nor did it give them blanket approval. It

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European Food Safety Authority (EFSA) will take the lead on approvals of all new applications for all food and feed deliberate release applications, rather than individual Member States.

[40] Of the other applications, the only ones involving cultivation (as opposed to import as commodities only) are for cotton (which is not suited to cultivation in the UK) and industrial starch potato (which is not intended for cultivation in the UK).

[41] Statement of 24 March 2003 on behalf of the Secretary of State for Environment, Food and Rural Affairs: see http://www.gmnation.org.uk.

[42] In addition, the Food Standards Agency (FSA) assessed consumer views through activities including surveys of young people and people on low incomes, a citizen's jury broadcast live on the internet, and a schools debate.

[43] *Field Work: Weighing up the Costs and Benefits of GM Crops*, Prime Minister's Strategy Unit, 11 July 2003. (Available at http://www.strategy.gov.uk)

emphasised that GM is not a single homogeneous technology and that GM applications need to be considered on a case-by-case basis. The Panel also emphasised the importance of GM regulation keeping pace with new developments. The Panel found that, for the current generation of GM crops, the most important issue was their potential effect on farmland and wildlife. We draw on the Science Review Panel's specific conclusions on gene flow and coexistence later in this report.

Supply of GM crops

36. It is important to have a clear understanding of how GM crops would reach the farmer for commercial production, if that went ahead. In the vast majority of cases, the agricultural biotechnology companies who have developed the GM events[45] will not develop and sell *seed* containing the GM event to farmers. A seed company will do that. The seed company selling the seed to farmers via seed merchants will not normally be the owner of the GM event and the part C consent holder. Rather, if a seed company were to sell a GM variety in the UK, it would be given a plant containing a GM event produced by an agricultural biotechnology company (such as Monsanto, Bayer or Syngenta). The seed company would make a cross to an agronomically useful variety suited to UK conditions, and then purify that variety in order to obtain a highly useful variety containing that GM trait. The biotechnology company, as the prospective or actual consent holder, would do all of the regulatory work including the environmental profiling of the GM.

37. Most UK seed companies are not owned by agricultural biotechnology companies. This is mainly because the UK market is seen by agricultural biotechnology companies as relatively unimportant in terms of global commodity crop production. Compared with major commodity crop production areas elsewhere in the world, only a relatively small amount of GM crops would ever be grown here[46]. So there will normally be a seed company as well as an agricultural biotechnology company involved in creating and supplying a particular kind of GM seed to UK farmers.

Our approach to looking for solutions

Listening carefully

38. We took a wide variety of evidence and listened to expert stakeholders[47], covering the spectrum of views on these difficult issues. We have been very conscious of the need to pay particular attention to the social and ethical dimensions around these issues, as well as the technical and legal ones, as we are charged to do in our terms of reference. We have sought to anchor our recommendations in the

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[44] GM Science Review Panel, First Report, 21 July 2003. (Available at http://www.gmsciencedebate.co.uk) The Science Panel has reconvened in autumn 2003 to consider its findings in the light of the results of *GM Nation?* and further scientific data, including the FSE results and comments on its first report.

[45] An 'event' in this context is a particular genetic modification leading to some effect in the plant, for example making a plant herbicide tolerant, or frost-resistant, or changing its colour.

[46] However, UK and EU decisions on GM crop and food approvals are important to agricultural biotechnology companies because of imports and the direct and indirect signals such decisions send to other parts of the world which do or potentially could be large GM crop production areas.

[47] See Annex E for more details.

wider social and political context in the United Kingdom and abroad. As noted earlier, we have had the facilitation of choice to consumers always uppermost in mind. Our report does not engage with all the general and specific points of debate around GM issues or even GM crops, but that should not be taken to imply that we were not acutely aware of all these, many of which have been current in the course of the public debate. We have developed this report against a broader canvas.

Limiting our scope

39. We defined the scope of our work in this report carefully, concentrating on key imminent aspects of decision-making:

- we limited our work to GM crops, excluding other GMOs. These will need separate consideration in future: we draw attention to our report *Animals and Biotechnology*[48], where we noted that the environmental impacts of GM animals, and particularly of fish and insects, might raise different issues from those raised by GM crops.
- within the range of potential GM crops, we have concentrated our detailed analysis on the first generation that might be commercially grown in the UK (that is, those which were included in the FSEs[49]), looking only briefly at other GM crops suitable for cultivation in the UK which may be nearing the approval stage. We would expect GM crops grown for pharmaceutical uses to require a different approach, and we have not considered GM trees. What we all recognise is that the approach taken to deal with coexistence and liability issues for this first generation of crops is likely to set the pattern, if not necessarily all the specific conditions, for any growing of future food and feed crops. So decisions at this stage to that extent represent a watershed.
- we have focussed on agricultural production as far as the farm gate (that is, the point when the crop leaves the farm for delivery to its immediate buyer, the merchant or the processor). Achievement of the desired standard at that point will carry through to the consumer only if the subsequent integrity of the chain is maintained. We have not made recommendations about those later stages[50], but we have taken them into account in making our recommendations.

Defining criteria for assessing solutions

40. In considering possible solutions to the issues we have considered, we have looked for options which would as far as possible:

- deliver choice for consumers
- allow farmers to deliver what consumers and markets want
- command support from a broad range of stakeholders, including the general public, farmers and the agricultural biotechnology and seed industries
- be achievable within the constraints of current or forthcoming EU legislation

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[48] AEBC, September 2002: see particularly paragraphs 57 and 115-117.

[49] Some of the existing first generation of GM crops is not suitable for UK farming conditions. For example, cotton, of which GM varieties are widely grown overseas, is not a UK crop; and Bt maize (designed to protect the plant against corn-borers (an insect pest) would not be in demand here because the corn-borer is not a significant pest in the UK due to our climate.

[50] The Food Standards Agency (FSA) is responsible for setting regulations on labelling of foods for GM presence, and local authorities are responsible for enforcement.

- be practicable in terms of farming practice and enforceability
- be consistent with delivery of environmental and future consumer benefits through farming
- be economically viable
- minimise disputes and claims, and facilitate dealing with any which did occur
- be proportionate to the issues being addressed
- be based on sound scientific and other evidence.

PART 2 COEXISTENCE

PART 2.1 CONSUMER AND PRODUCER CHOICE

Coexistence and choice

41. At the heart of the coexistence debate is consumer choice, predominantly expressed as domestic[51] consumers being able to continue to choose to eat non-GM or organic products, particularly products grown in the United Kingdom. Sometimes also raised in public debate is the corresponding case of access to home-grown GM produce for some consumers.

42. Demand for non-food and feed crops, however, need not be driven by domestic consumers. The customer may for example be an industrial fuel or lubricant producer, not a supermarket or food processor. Although initial GM crop introductions into the UK are likely to be for GM herbicide tolerance, future genetic modifications will produce crops designed for specific purposes such as nutritional qualities, specialist oils, disease resistance and energy crops. Some of us take the view that although the principal issues around coexistence relate to food and feed products, it is important that any action taken to seek to resolve those issues and deliver consumer choice should not as a consequence rule out production of non-food GM products, where there may be new markets for farmers, even in the short-term.

43. For farmers the predominant factor governing production will increasingly be market demand, from domestic or industrial consumers, as distortions to the market from production-based subsidies are reduced. Preserving choice for farmers is important in the sense that they need to be able to respond to changes in consumer and market demand. In the future, if there were to be widespread commercial growing of GM crops for food and feed, then this might indicate in itself that there was greater consumer and farmer acceptance and so less market pressure in general to meet low adventitious thresholds. Other scenarios are also possible. Reconnecting farmers with their markets is a key element of Government strategy for agriculture in the wake of the Curry report.

44. At present, domestic farming in the UK is able to deliver to consumers a choice of crops[52] grown by means of different conventional or organic agricultural production systems, but not GM crops. If the commercial production of GM crops made it impossible over time for UK farmers to produce crops meeting the respective thresholds, consumers would no longer be able to choose to buy domestically produced non-GM food (defined in law as below 0.9%); or organic food, at a 0.1% threshold (the self-imposed *de facto* threshold that has been adopted by the Soil Association, one of the main UK organic certification bodies, which has taken a public lead on the issue among organic certification bodies)[53]; nor might they be able to buy so easily non-organic food whose ingredients were at a commercially imposed

[51] Individuals and households, rather than businesses.
[52] Although in practice CAP subsidies have had a warping effect on the operation of this market.
[53] We are not aware of any of the other UK organic certification bodies adopting a threshold different from that of the Soil Association.

level below 0.9%. On the other hand, prohibiting the domestic cultivation of GM crops would deprive consumers of the possibility of buying domestically produced GM food (and non-food products). In any of these cases, imported products would be available as substitutes (some 56% of organic food by value at present is imported), but that would not help UK farmers respond to UK consumer demand.

45. The European Commissioner for Agriculture has expressed the principle that "farmers should be able to cultivate freely the agricultural crops they choose, be it genetically modified crops, conventional or organic crops". He recognised that, unless special measures were taken, the commercial cultivation of GM crops might result in the "adventitious presence of GM crops in non-GM crops and vice-versa": in other words, GM plant material might turn up in a crop which was intended to be non-GM, or vice versa[54]. Coexistence gives rise to potential economic consequences for farmers, because as a result of adventitious presence a crop might fail to meet the relevant standards[55], and therefore command a lower price on the market. As noted in Part 1, there is now legal authority for Member States to implement national measures to promote coexistence.

46. Delivery of consumer choice also depends, among other things, on the operation of the supply chain beyond the farm gate. We have kept in mind the operation of the rest of the supply chain in our considerations about coexistence at the farm level.

47. In this section, we look at some of the background to the choices available to consumers (and farmers) in respect of non-GM, organic and GM foods and crops.

Factors in domestic consumer decision-making

48. Domestic consumer decision-making is a specialised field: we include only a very brief summary here of some key factors to help illuminate some of the background to underlying issues relating to consumer choice and GM food.

49. Consumer analysts commonly use a set of seven filters or questions to help assess the extent to which policy propositions are fit for the consumer purpose. One of these is choice. The others are information, access, safety, equity, redress and representation. But these seven filters are not mutually exclusive. When consumers make decisions some of the questions will be more important, depending on the decision and the consumer. And consumers will make trade-offs between the areas, even if they do not do this explicitly.

50. Only very rarely is this choice filter relevant on its own. The principle is that there should be as much choice as possible, but "possible" will be defined according to the nature of the decision. In public services, for example, consumers are often prepared to have restricted choice in the interest of universal access.

51. *Having a choice* involves:

[54] Communication from Commissioner Fischler to the European Commission, Brussels, SEC(2003) 258. 25/02 2003. *Coexistence of Genetically Modified, Conventional and Organic Crops*

[55] These standards could include both thresholds of permissible GM presence in conventional or organic crops, and standards of purity in high-value specialist GM crops.

- being able to meet one's needs and fulfil one's desires (subject to one's available income[56]) – which raises issues about access, equity and redress
- being able to choose between products of various prices, qualities and characteristics – which raises issues about information
- having confidence that risk has been managed out, or that one is taking risks knowingly – which raises issues about safety, information, representation and redress
- being able to choose to limit one's own choice in deference to equity

52. To be meaningful, choice must be based on *information* which is relevant and usable. The information must be timely, appropriate to the decision, accurate and trustworthy. In terms of GM food and crops this might imply that information must at least be demonstrably correct on the basis of testing and/or traceability.

53. And consumers should have *access* to the goods and to information about them. Barriers to access (which are not specific to biotechnology) can include geography, disability, level of education and skills, income and availability. But the market, and producers and retailers within it, can also impact on access, as can regulators and public policy makers.

54. In relation to *safety*, consumers wish either to have risk managed out, or to know what risks they are taking so that they can weigh them against the potential benefits. Consumers will typically wish to be protected against risks which are unknown but potentially substantial, and which will either affect many people or affect a few people greatly. For products containing GM material, consumer safety concern where it exists is likely to relate to human safety at the point of consumption. For some consumers, concerns about environmental safety will also be a factor. Although the safety risks may be perceived as small, the risk/benefit equation may be far from straightforward for consumers if the first generation of GM crops offers only limited direct consumer benefit. Wider choice of new GM products with a perceived direct consumer benefit could affect the choice which the consumer makes.

55. Considerations of *equity* relate to the fact that one person's choice affects others:

- it may restrict the choice of other consumers. If GM products have proven utility, some people will choose to have them, but others will still want the choice not to have them: both groups may want to be assured that their personal choices will not be affecting others

[56] Most surveys show that consumers are generally uneasy about GM food, but there is varying evidence as to how high avoiding it comes in their list of priorities. Consumers in surveys generally put price at the top of their list (see Food Standards Agency consumer surveys, http://www.food.gov.uk), followed by animal welfare and environmental issues, with GM a considerable way down the list. But looking at this from another angle, it can be argued that the reason price is top of the list of concerns is simply because most people are shopping on a budget. Research with low-income consumers undertaken by the National Consumer Council (*Feeding into Food Policy: Submission to the Farming and Food Policy Commission on the views of low-income consumers*, National Consumer Council, November 2001, http://www.ncc.org.uk) as part of its evidence to the Curry Commission indicated that the participants cared deeply about the food they ate and how it was produced. Despite being on low incomes their concerns ranged far beyond merely ensuring affordable food was available to them.

- it may affect the interests of others who need protection (for example by having an impact on consumers and employees in developing countries)
- it may affect the environment, hence having an impact on inter-generational equity

56. Generally speaking in consumer decision-making, provision of adequate *redress* at both individual and collective levels requires that if things go wrong there will be easy access to a simple, well-publicised, rapid, equitable system, providing adequate compensation and an assurance that things will be better for others.

57. Consumers need *representation*. They should be involved, so that their needs are identified, their concerns are met, and their interests are given equal weight with those of producers. Consumers will want to be reassured that issues around coexistence are being considered holistically.

58. So consumer decision-making in relation to GM foods is not a simple matter of exercising a choice between two products at the food counter. Also essential are to:

- understand what consumers want and need
- provide meaningful information
- assure sound risk assessment and adequate precaution
- establish utility
- provide clarity about the equity implications of options
- establish a system of redress
- be transparent about these with consumers.

Demand for specific products

Consumer demand for 'non-GM' products as interpreted by retailers

59. The producers and retailers of food products translate consumer demand into demand for farmers' output. UK supermarkets perceive their customers as demanding non-GM food. Their own-brand products are therefore non-GM (which at present means that they must contain less than 1% of GM material).

60. But the supermarkets state that they are going further than this. We have been told variously that they are working "at", "to" or "towards" remaining within a 0.1% threshold, not merely for products described as organic, but for a wide range of their own-brand products (we are not sure if the supermarkets distinguish between premium and non-premium own brands in this respect, but have heard no evidence that they do). The supermarkets state that they seek to achieve this partly through testing, but partly through identity preservation (IP) systems. On 13 February 2002, John Longworth, Director of Trading Law and Business Affairs, Tesco Ltd (and Chairman of the Directors Technical Forum of the Institute of Grocery Distribution, and a member of the Food Policy Advisory Group for the British Retail Consortium) said in evidence to a House of Lords Committee[57]: "Tesco brand as a range has no

[57] House of Lords Select Committee on the European Union, *Labelling and tracing of GM food and animal feed: informing the consumer*, HL Paper 92, 15th Report Session 1998-99, QQ 69 and 71. This Report also contains other interesting evidence.

GM or GM derivatives in it ... We decided to remove the GM from the Tesco brand in order to provide a choice between Tesco brand and the branded products which we sell in our stores as well ... Customers showed their preference to the extent that the branded manufacturers then decided to remove GM from their products too ... I am not aware that another supermarket is intentionally selling GM"[58]. The UK's principal supermarkets recently confirmed that this remains their policy, based on their assessment of consumer wishes[59]. A recent survey by BBC News On-line confirmed this[60]. The Co-operative Group has announced that as well as banning the sale under its own brand label of any products that contain GM ingredients, it will not allow the growing of GM crops on its land[61]. However, supermarkets continue to sell products manufactured using GM processing aids, notably vegetarian cheese, which is not required to be labelled as having been produced using GMOs.

61. GM animal feed (particularly soya) is already used in conventional livestock production in the UK. Some sectors, such as the poultry industry, use non-GM feed only, and all organic livestock production avoids using GM feed, but non-GM sourcing has not been adopted across the industry, partly as a matter of interpreting consumer demand for products derived from livestock fed specifically on GM material, and partly because of question marks over whether this would be practicable, particularly given the heavy use of imported soya products for livestock production.

62. The British Retail Consortium (BRC) describes itself as the lead trade association representing the whole range of retailers, from the large multiples and department stores through to independents, selling a wide selection of products through centre of town, out of town, rural and virtual stores. According to its website[62], "retailers will consider the sale of GM food to foods containing GM ingredients, provided they have clear approval from the regulatory authorities and where they have confirmed a clear customer demand. Such demand could arise from the offering of food that demonstrates a real benefit to the consumer, for example, food which has an enhanced nutritional content, an improved taste or keeping quality or a lower price … Retailers are committed to giving their customers informed choice". As noted above, this policy has not changed, nor have the BRC or leading retailers given any indication that it is likely to do so in the present circumstances.

63. A recent survey in 2003 by IGD, which provides data services on consumer attitudes for the food and grocery industry, found that in terms of consumers' attitudes in practice, "GM currently appears to [be] making little difference to

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[58] He did not at that time suggest that Tesco or other supermarkets were aiming for a level of GM content below the 1% prescribed in EU legislation.

[59] From *The Guardian*, 'Shops' unlikely to stock GM', 16 July 2003: "Richard Ali, director of food policy at the British Retail Consortium, said: "Our position remains unchanged. We are neutral on GM technology. But we provide what customers demand and they do not want GM food." Mr Ali said a shift would probably come only if it was proved that GM products had tangible benefits for consumers - for example, extra vitamin content. The communications director for Safeway, Kevin Hawkins, said: "I think it's very difficult to see what will move public opinion. We have certainly seen no change in what people think about GM." Kate O'Sullivan of Sainsbury's said: "Customers have made it clear they do not want GM ingredients." Tesco and Asda also said they had seen no radical change in public attitude."

[60] *Where supermarkets stand on GM food*, BBC News On-line, 21 October 2003. (http://news.bbc.co.uk/1/hi/uk/3211510.stm)

[61] Co-operative Group announcement, 20 October 2003. The Co-op is the UK's single largest farmer.

[62] http://www.brc.org.uk.

consumers' shopping patterns. Instead, most are showing a passive acceptance of GM food"[63]. This conclusion was based on the following breakdown of responses:

- 47% I am not really interested in looking at the list of ingredients in the food I buy
- 27% I would prefer not to buy any GM food but I rarely look at the label to make sure this is the case
- 13% I always look at the label to make sure the food I buy does not contain any GM ingredients
- 13% I am quite happy for the food I buy to include GM ingredients.

These results would appear to be at variance with an opinion poll of Co-op customers carried out prior to the Co-op's October 2003 policy announcement, in which 79% of the 1183 people surveyed said they would not knowingly buy food containing GM ingredients[64]. Either way, there appear to no signs at present as far as we can judge of a significant shift on the part of UK retailers from a stated policy of avoiding GM in their own produce.

Demand for organic products

64. At present, organic food retail sales (with a value of over £1 billion) account for around 2% of total retail food sales in the UK[65]. Of the organic food sold, some 44% by value is domestically produced[66]. The UK organic farming sector has been growing, and is likely to continue to do so, driven both by demand and by Government policy, even if not for every product (for example, there has recently been an oversupply of organic milk in the UK).[67] A recent survey predicts 10% average annual growth between now and 2007, taking the annual value of organic sales to a projected £1.6 billion[68].

65. There is room for argument (based on the results of different surveys) about the extent of demand for organic products in relation to the price premium, as well as about what the general public understands "organic" to mean[69] in respect of adventitious presence of GM material. But the basic facts of level of demand are clear enough. To some of us, the Government support of organic agriculture is at variance with its declared policy in response to the Curry Commission that trade-distorting support should be removed.

Demand for "GM" products

66. Retailer sourcing decisions are based on an assessment that there is not at present significant positive consumer demand for food containing GM material from the first generation of GM crops. Proponents of GM crops generally accept that

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[63] IGD, Consumer Watch 2003**.** *August's Edition: GM Food and Farming: What are Consumers' Latest Views?*, (http://www.igd.com/consumer)

[64] Poll carried out by NOP World

[65] *Organic Food and Farming Report 2003*, Soil Association, (November 2003)

[66] *Action Plan to develop Organic Food and Farming in England*. Published by Defra, July 2002

[67] Defra prepared a note on likely demand in conjunction with the Organic Action Plan which can be viewed on the Defra website at www.defra.gov.uk/farm/organic/actionplan/prospects.htm.

[68] *Organic growth hampered by price barriers,* Datamonitor, 31 October 2003.

[69] In a recent article on organic food, *Which* said "Organic food shouldn't contain any GM ingredients, but it's not proven that pollen can't drift from where GM crops are being grown, so it's difficult to rule out fully the chance of contamination. But shopping organically does support farming methods that many consider more beneficial to the environment and to the welfare of farmed animals" (May 2003, p22).

particular kinds of maize, soya or oilseed rape[70] products, GM or not, are not products likely to grab consumers' attention. They are ingredients in food or refined oils, or used as animal feed, rather than a clearly distinct product which might be perceived to offer clear consumer benefits. Future GM crops with distinctive direct consumer benefits might be more popular. Or some consumers might buy some GM varieties in the future on the grounds that they had been produced in more environmentally friendly ways than conventional equivalents – *if* there was generally accepted evidence of this for the crops in question. What is clear is that, as the PMSU report on the costs and benefits of GM crops concludes, the extent of GM crop cultivation in the UK will in large part be determined by public attitudes. Obviously Government policy would need to permit their cultivation if farmers were to be able to respond to future consumer demand for GM products.

67. Public views do seem to distinguish to some extent between commercial food and non-food and non-feed applications of GM technology, as well as possibly between different kinds of GM food products. Some of us think that, particularly given the potential environmental benefits from greater use of renewable energy sources, non-food GM energy crops could attract greater levels of public acceptance than GM food or animal feed crops enjoy at present.

68. Organic food is sold on the basis that no agrochemicals are used in its production; however 98% of the food in the UK is produced with the aid of agrochemicals at lower cost. While the consumer may express a wish for food to be produced in the absence of artificial fertiliser or herbicide, when provided with the choice of higher priced organic or lower priced conventional food the majority of consumers clearly opt for the conventional product. Some of us would extend the same argument to GM food products, which could be produced at lower cost and high quality. Indeed when a GM tomato product was sold in the UK at a competitive price to its conventional competitor the GM product achieved significantly higher sales[71]. Thus to restrict the production and sale of GM products, other than for reasons of human health or environmental safety, would be to restrict the exercise of choice by the consumer.

Information for consumers

Labelling

69. For consumers to make an informed choice in relation to genetic modification, products need to be appropriately labelled[72]. Legislation already provides for labelling where a product has a content of GM elements above a certain percentage level (at present 1%, but to be reduced soon to 0.9%). The new European Directives on food and feed and traceability and labelling provide for similar labelling if an ingredient of

[70] Most soya products, GM and non-GM, are used in animal feed rather than food.

[71] GM tomato puree was on sale in Sainsbury's and Safeway from 1996, clearly labelled as such. It was made from GM tomatoes that contained more solids and less water than conventional varieties. It was sold between 10-15% cheaper than the conventional puree. The GM variety substantially outsold the conventional equivalent but following the public controversy about GM foods from 1998 onwards, the tomato puree and other GM products were largely withdrawn by major retailers and food manufacturers.

[72] For more detail, see Annex A.

a product has a content of a GM-*derived* element above the same percentage level, even if no GM elements are detectable in the final product[73].

70. For products marketed as organic, European law does not at present contain any more stringent threshold for GM *content* than the one that applies to all "non-GM" products, though it does ban the *use* of GMOs in organic production. There is provision for the introduction of a "*de minimis* threshold for unavoidable contamination which shall not be exceeded"[74]. But no such threshold has yet been agreed. At the 29 September European Council discussion, a number of Member States' delegations wondered about the need for a specific tolerance threshold for the adventitious presence of GMOs in organic agriculture and wanted this discussed further[75]. There is some ambivalence among EU Ministers: they feel that organic products should be GM-free in principle, but are worried about the costs for the organic sector of setting a lower threshold. We understand that there is likely to be a European Commission proposal recommendation on what to do about setting an organic threshold as part of their organic action plan due to be published in March 2004.

71. EU legislation on organic products is enforced in the UK by Government. Government may establish its own standards where EU legislation is silent. Rather than police organic standards itself, Government's focus is to ensuring that certifying bodies correctly interpret and implement them[76]. Organic certifying bodies require operators to take all reasonable measures to prevent the use of GMOs, and they maintain the right to remove the organic status of a crop where traces of GM are found in it, or where a significant risk of "contamination" is established and the farmer is unable to take steps to avoid it. They may also remove the certification of a field or an entire farm in certain circumstances[77].

72. As noted earlier, the Soil Association[78] maintains a self-imposed stance of 'zero tolerance' to adventitious presence of GM material in any product described as organic[79]. This is a departure from its normal approach, which depends on production method rather than analysis of output and so does not have zero tolerance of other unwanted material, like insect parts and pesticide residues, present to a greater or lesser extent in any crop, whether organic or not. This policy is seen by some of us to be directed towards establishing a barrier to any production

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[73] Products which are not so labelled and not organic are referred to in this report as "non-GM".

[74] In a new Article 13 inserted into the original 1991 Regulation by the 1999 Regulation, allowing for the adoption of implementation measures under a special procedure prescribed by Article 14.

[75] See http://ue.eu.int/pressData/en/agricult/77451.pdf.

[76] Defra and the devolved administrations produced in March 2003 a draft new compendium of organic standards, (http://www.defra.gov.uk/corporate/consult/organic-compend/index.htm.) which was the subject of consultation and is now being developed in the light of comments received.

[77] Ministers have established an Advisory Committee on Organic Standards (ACOS) as a successor to the United Kingdom Register of Organic Standards. ACOS will advise Government on organic standards, approval of organic certifying bodies and research and development.

[78] Among organic certification bodies, the Soil Association's certifying arm, SA Cert Ltd, certifies more farmers and growers than any other individual body in the UK (2308 out of 4057 at December 2002). The Scottish Organic Producers Association (SOPA) covers the largest area of farmland (378697 out of a total area of 724523 hectares that are organic or in conversion), by virtue of the extensive livestock farming common in Scotland. Organic Farmers and Growers is the second largest in terms of number of members, with 945 members. SOPA has the third biggest membership (558 farmers and growers). The remaining bodies all operate on a much smaller scale than these three.

[79] SA Cert Ltd. handles inspection and certification on behalf of the Soil Association in accordance with that principle.

of GM crops in the UK. The Soil Association says that its adventitious presence standard reflects its interpretation of what the market expects from organic foods (including the integrity of the system as a whole, the values it encompasses in terms of promoting human and environmental safety and therefore confidence in the organic sector, and its market future)[80]. The Soil Association at present works on the basis that a 0.1% threshold is the lowest practicable, reliably detectable limit and that this threshold can therefore stand as a proxy for 'zero' adventitious presence[81]. Any breach of this and the Soil Association would not permit the product to be labelled as organic. Other UK organic certifying bodies have been less prominent in the debate, but we have had no indication from others of plans at present to adopt a more relaxed threshold.

73. Informal soundings suggest that organic certifying bodies in other European States vary to some extent in the approach they are taking to setting a specific threshold for organic produce in addition to the statutory threshold of 0.9%. In at least some countries besides the UK, including Italy, Denmark and Austria, they seem generally to have a policy of working to a lower threshold than 0.9%; others have taken no formal position on a threshold, although all organic producers would almost certainly wish to keep their product below the 0.9% level so as to avoid having to label organic produce as containing GM material. Internationally there is a wide variation on the status of labelling of products on the grounds of adventitious presence, and in the threshold for labelling, as the table below shows. Most of the countries in Table A have not as far as we are aware adopted formal coexistence measures[82].

TABLE A. Non-GM labelling thresholds.

Country	Status of labelling	Adventitious presence threshold	Notes
Argentina	None required	No specific figure	No formal coexistence arrangements
Canada	Voluntary	No specific figure	No formal coexistence arrangements
USA	Voluntary	No specific figure	No formal coexistence arrangements
New Zealand	Mandatory	1 %	Coexistence measures would be developed on a crop by crop basis and specified in crop release consents[83].

[80] Evidence given at stakeholder seminars and informal meetings.

[81] "Our position is that the issue of co-existence must include the continued possibility of GM-free production (with a maximum 0.1% contamination 'threshold'); that the costs of preventing contamination or for any negative consequences must be borne by those seeking to gain from GM crops in particular the biotechnology companies; and that if it comes to a choice between organic and GM production then organic farming should be prioritised because of its proven environmental benefits, consumer support and Government commitments." *GM crops policy update March 2003*, Soil Association, March 2003.

[82] Source: http//www.isaaa.org/kc/issues/labelling.

[83] At present no GM crops are grown in New Zealand. GM commodity crops such as soya and maize are unlikely to figure large in New Zealand: other crops would be more suited to the local agricultural mix. The Royal Commission for New Zealand recommended that a crop-by-crop industry code of practice to ensure effective

Australia	Mandatory	1 %	Cotton is the only GM plant cultivated commercially in Australia to date.
China	Mandatory	0 %	-
Brazil	Mandatory	4 %	GMOs banned but with recent one season waive on ban; however illegal import of seed has already led to growing GM crops in parts of the country.
Russia	Mandatory (selected products)	Data not available	-
Switzerland	Mandatory (for feed)	3 %	-
Japan	Mandatory (selected products)	5 %	24 products so far identified from maize and soya beans
Saudi Arabia	Mandatory	1 %	-
Czech Republic	Mandatory	Data not available	No product has yet appeared with new label
Thailand	Draft	Data not available	-
Taiwan	Draft	5 %	-
Israel	Draft	1%	Proposals in general follow EU model
Malaysia	Draft	3 %	-
Hong Kong	Draft	5 %	-
India	Draft	Data not available	-
South Korea	Mandatory	3 %	Only if GMO is one of top 5 ingredients

separation distances between GM and other crops (including seed crops) be set up, but that there was some merit in waiting to see which crops might be grown first in New Zealand before making general provisions. The code should take into account distances required for seed certification and also developments in international certification standards for organic production and also any emerging strategies for coexistence in other countries. In the meantime, the New Zealand regulator, the Environmental Risk Management Agency (ERMA) expects to specify coexistence measures in consents for applicants or registered users (including abiding by separation distances set by ERMA, registering locations of GM crops, storage requirements, etc). The New Zealand Government has decided at this stage not to set up the new nationwide mediation service recommended by the Royal Commission, preferring to rely on existing mechanisms and keep the situation under review. The Government has also encouraged the adoption of a strategy to mitigate the impacts on honey arising from any release of GM flowering, and strategies to help preserve the long term effectiveness of Bt insecticide. Although GM organisms and products derived from them are expressly prohibited from deliberate use in organic production world-wide, the New Zealand organic rules are currently silent on the unintended presence of GM material in organic products. (Source: Government response to Royal Commission on Genetic Modification: Report on Managing the effects of GM organisms and coexistence in primary production. 17th April 2003. Available from Ministry of Agriculture and Forestry, Wellington, New Zealand, http://www.maf.govt.nz/mafnet/rural-nz/research-and-development/biotechnology/index.htm.)

74. What it is actually possible to tell consumers about the GM content of products, or of ingredients, will depend on the accuracy with which it is possible to test products or to trace the origin of products or their ingredients.

Testing for GM content[84]

75. We have considered the various methods available to test for the presence of GM constructs. The two protein-based tests have limitations; a more reliable test that amplifies DNA for testing takes longer and is more expensive. The effectiveness of testing depends in part on the proficiency of individual laboratories, and at present there is limited laboratory capacity.

76. The lower the level of GM presence that is desired, the larger the sample has to be. It is generally agreed that 0.1% is the lowest level that can reliably be detected in practice and that even if techniques of analysis improve, that level is unlikely to fall. This is because testing for lower thresholds, although possible, would require very large samples and would be much more costly and so is not a practicable option for commercial crop production. Accurate testing requires a crop to be thoroughly mixed making it very challenging to test to the level of 0.1% on the farm, although easier at the processing stage, by which time there would probably have been much more thorough mixing. It is not certain to what extent farmers and producers would in practice be willing or able to meet this requirement. Having thresholds for GM material is not unique: no harvested crop can avoid containing some foreign material. Processors operate thresholds for impurities such as insect parts, other crops, weed seeds etc. The value of a crop is affected if these are excessive, but some tolerance is built into normal production and trading. There are also tolerances for non-organic material in some aspects of organic production, such as allowing at present 10% (for herbivores) or 20% (for other species) of animal feed for organic livestock production to come from non-organic sources where sufficient quantities of organic feed are unavailable. Some of us think that there is no logical case, legal considerations aside, for testing for GM material to any greater or lesser extent than testing for other impurities.

77. Work is being coordinated by the European Commission's Joint Research Centre, involving laboratories in different Member States (the Central Science Laboratory here), to standardise testing to the best available molecular techniques (closed system PCR), with standard sample sizes and sensitivity. This will allow the consumer to be confident that he or she is not being presented with misleading comparisons of genetic purity in different products depending on the country of origin, at least within the EU. The World Health Organisation (WHO) and the European Committee for standardisation are currently working towards harmonising protocols for GM testing methodology across the International Community.

Traceability

78. The labelling legislation[85] will extend the current labelling provisions to all food and feed produced from GMOs, even if no DNA or protein of GM origin is detectable

[84] See Annex B for detailed information on testing and its limitations.

[85] Regulation (EC) No 1829/2003 of the European Parliament and of the Council of 22 September 2003 on genetically modified food and feed; and Regulation (EC) No 1830/2003 of the European Parliament and of the Council of 22 September 2003 concerning traceability and labelling of genetically modified organisms and

in the final product. Because testing the actual product being sold would not tell the consumer how it had been produced, a traceability system would require each operator in the production and distribution chain to transmit to the next operator information that a product consisted of, contained or (in the case of food or feed) was produced from GMOs[86].

79. When the traceability requirements enter UK law, it is not yet clear what monitoring and enforcement arrangements would apply[87]. The traceability requirements encompass the whole food chain, which obviously includes products as they leave the farm.

Recommendation 1: The main aim of Government policy on coexistence of GM and other crops must be to facilitate consumer choice to the greatest possible extent, while allowing UK farmers to respond to present and future national and international market demand.

traceability of food and feed products produced from genetically modified organisms and amending Directive 2001/18/EC. The food and feed regulation entered force on 7 November 2003 and applies from 18 April 2004. The labelling and traceability regulation also entered force on 7 November 2003 and will apply 90 days from publication of a system for development and assignment of unique identifiers for GMOs.

[86] Because there is frequently no detectable difference between refined products from GM and from other crops, labelling will depend entirely on traceability, often across international boundaries.

[87] At present, the Food Standards Agency (FSA) is responsible for setting regulations on labelling of foods for GM presence. Local authorities are responsible for enforcement. The GM Inspectorate (based at the Central Science Laboratory for England and Wales, and the Scottish Agricultural Science Agency for Scotland) is responsible for monitoring and enforcement of conditions on consents to cultivate GM crops.

PART 2.2 CRITICAL CONTROL POINTS FOR COEXISTENCE

80. We have considered whether it might be possible to introduce coexistence arrangements to maintain genuine choice in the event of a decision to allow the production of one or more GM crops on a commercial scale.

The critical control points

81. We looked at the critical points where adventitious presence might be introduced into a non-GM crop on the farm, in order to consider what action might be taken to avoid this happening[88]. We identified the following possibilities:

- some GM material may have been present in seed purchased as non-GM or farm-saved
- there may have been gene flow by cross-pollination between the non-GM crop and a neighbouring sexually compatible GM crop of the same species
- seeds arising from a previously planted GM crop may have survived, as volunteers, until a non-GM crop of the same species is grown in that field
- plants from a GM crop may have pollinated certain sexually compatible wild relatives, which may then have survived in field margins to cross-pollinate with a succeeding non-GM crop of the same species
- the integrity of the non-GM crop may not have been maintained up to the farm gate[89]

We look separately below at each of these possible causes of adventitious presence, and at the steps that can be taken to minimise it. More details of the lifecycles and particular issues arising in relation to each of the FSE crops are given in Annex C.

Seed purity

82. Seed is either purchased from a merchant or farm-saved.

83. Seed sold by a merchant as non-GM may contain some GM material. At present there are no legally established thresholds for seed, only an EU guideline of 0.5% for authorised GM events and 0% for unauthorised events. Seed production relies on identity preservation systems with testing only undertaken for 'at risk' crops (such as oilseed rape or maize). Proposed EU legislation[90] would set maximum thresholds for seed production, designed to enable crops grown from "non-GM" seed to meet the threshold specified for a non-GM final product (1% now, soon to be 0.9%). Levels of GM presence in seed would need to be monitored by identity preservation systems[91]. The higher the GM content in the seed, the less "headroom" there would be for keeping below the threshold of 0.9% for the presence of GM constructs in the tested

[88] We have limited our consideration to critical points up to the farm gate (that is, up to the point where the product leaves the farm for delivery to its immediate buyer, the merchant or the processor). Product integrity must then be maintained throughout the food chain, through storage and processing, but that is beyond the scope of this report.

[89] These factors were considered by the Scientific Committee on Plants (CONT/002-FINAL 13 March 2001) Opinion of the Scientific Committee on Plants concerning the adventitious presence of GM seeds in conventional seeds.

[90] Commission proposals on thresholds for the adventitious presence of approved GMOs in seeds, (SANCO/1542/02July2002). See Annex A.

[91] With the processes and provenance open to inspection by the GM Inspectorate.

crop material[92], and the more likely it would be that a 0.1% threshold would be breached.

84. On the 0.1% threshold, given that the planned threshold for seeds is between 0.3% and 0.7% depending on the crop, special arrangements might be needed for organic seed production for some crops, and for the production of non-organic seed if non-GM farmers were working to a similar threshold, were GM cropping of the relevant crops to become widespread. This is because a batch of seed not labelled as GM because it is below the labelling threshold could in fact cause a breach of the 0.1% threshold in the final harvested organic or non-GM crop because the level of GM in the seed was greater than 0.1%.

85. Organic farmers are already finding some difficulty in obtaining sufficient organic seed for some crops and a derogation is in place at present. Although we understand that the present supply problems are unrelated to GM crop cultivation, widespread GM cultivation could in time add to these supply difficulties. This would be a greater problem for organic agriculture were GM varieties of more popular organic crops than niche products such as organic oilseed rape to become available and be widely grown, and a 0.1% organic threshold maintained (unless cultivation of presently niche organic crops increased markedly). On present cropping patterns, however, only a very little seed (0.5 tonnes) would be needed to supply the entire organic market. This would not be difficult to produce.

86. Maintaining consumer choice for organic and non-GM produce as presently defined will depend on the continued viability of organic and non-GM seed production respectively. There would be potentially a much bigger problem presented by adventitious presence in seed if many non-GM farmers were working to a similar 0.1% threshold as organic producers, as much greater volumes of production would be affected[93].

Farm-saved seed

87. Farmers may legally save seed of certain crops licensed by the British Society of Plant Breeders (BSPB), subject to payment of a fee[94], and for hybrid varieties subject also to the permission of the individual breeder of the variety concerned. Farmers are legally obliged to provide details of their use of farm-saved seed[95]. Oilseed rape is the only one of the FSE crops for which it is practicable for seed to be farm-saved provided permission of the individual breeder is given[96]. It is possible that levels of

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[92] We note that a certain percentage level of GM presence in seed (n%) does not necessarily of itself cause an adventitious presence level as high as n% in the crop material, because of inheritability and expression considerations. Seed containing up to n% of GM material would in most cases be expected to produce a crop with between 0.75n% and n% GM material.

[93] In their October 2003 position statement on GMOs the statutory conservation agencies press for legislation to set and enforce standards of seed purity that ensure adequate protection of the environment. They state that this is not just a consumer choice issue, noting that out-crossing from some GM crop plants could lead to gene-stacking and consequently more damaging herbicides or weed control practices being used to control volunteers or weeds.

[94] From which "small farmers", as defined for the purposes of IACS, are exempt.

[95] The royalty collection scheme for farm-saved seed could perhaps be used to monitor adventitious presence levels in farm-saved seed too.

[96] Maize seed cannot be produced in the UK because of climatic conditions: it is all imported from the EU or the USA. There is no farm-saved beet seed in the UK, nor is there ever likely to be, for a combination of technical, agronomic and (monopoly) purchaser reasons. For oilseed rape, conventional farmers make significant use of farm-saved seed: estimates of the percentage of oilseed rape seed in the UK which is farm-saved vary from 15-20% (NIAB) to some 40% (coexistence stakeholder seminar).

GM material in what was supposed to be non-GM farm-saved seed could accumulate over the years if GM cultivation becomes relatively common. If GM cropping were on a small scale, the level of GM could not accumulate over time due to heterozygosity.

88. If GM production were pervasive, it is argued that it may become difficult to save non-GM seed from crops on farms where GM oilseed rape had been grown, because gene flow would occur from GM seeds in the field seed bank as well as from GM pollen dispersal[97]. Organic farm-saved seed would need to be produced from crops with very effective isolation (for example, by using only seed harvested from the centre of field crops).

89. It could be, therefore, that it would no longer be sensible for some or all farmers to save non-GM oilseed rape seed if GM cropping of oilseed rape became widespread, depending on how low were the thresholds to which farmers were working (the UK organic oilseed rape market would require only around 0.5 tonnes of seed in total each year, which could be supplied easily). At the very least, farmers saving their own seed might wish or could be required to take the precaution of having it tested before use, rather than risking producing a crop that would fail to meet the threshold, or inadvertently affect a neighbouring crop. Such testing could be expected to be made a condition of claiming on any compensation scheme for economic loss arising from adventitious presence. It may be that the non-GM farmer would have sometimes to buy seed rather than save it, if GM cropping were widespread. This could impose a new cost, therefore, on the non-GM farmer if GM crops were commercialised, which would be expected to be reflected in a price premium for the crop. It could also restrict the ability of farmers to choose farm-saved seed as an agricultural option.

Gene flow through cross-pollination

90. A non-GM crop could cross-pollinate with a sexually compatible neighbouring GM crop. The potential for gene transfer from cross-pollination is very different depending on the crop and the variety[98]. For example, wheat mostly self-pollinates; maize is the opposite.

91. Suitable separation distances between GM and compatible non-GM crops can very significantly reduce the amount of adventitious presence caused in the non-GM crop *by cross-pollination*[99]. The separation distance is measured between the boundary of a GM crop and that of a non-GM crop of the same species[100]. In addition to separation distances, pollen barriers[101] may minimise or prevent pollen spread.

92. Peculiar local conditions of wind-caused pollination or insect activity could increase the distance over which cross-pollination might occur. There have been observations which suggest that, even on a whole-field analysis, in some fields at

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[97] *Round Table on Coexistence: Rapporteur's Report on Session2: Oilseed rape.* Jeremy Sweet, NIAB, UK. (http://europa.eu.int/comm/research/biosociety/pdf/rt_oilseed_rape_rapporteurs_%20report.pdf)

[98] Moreover, it is important to note that it is only the distance *viable* pollen travels that is important for coexistence.

[99] *Report on the separation distances required to ensure cross-pollination is below specified limits in non-seed crops of sugar beet, maize and oilseed rape*. Jan Ingram, 2000.

[100] Which could be on a neighbour's land or on the farmer's own land.

[101] Barriers of a different non-compatible plant species, normally tall species such as hemp, miscanthus or rye, planted around the GM crop; or, say, planting beside a wooded area; or a buffer zone i.e. a non-GM strip of the same variety as the GM crop which will be treated as GM post-harvest.

some times separation distances designed to meet a threshold of 0.1% from cross-pollination would fail to do so[102].

93. In relation to gene flow from cross-pollination it has been suggested that there could be a "scale effect" of "pollen flooding" as the level of production of GM crops increased. Some have reservations as to whether a regime designed on the basis of data on gene flow obtained from relatively small scale studies would be adequate to cope with a potentially much greater area of commercial crop production. The studies have estimated the distance which viable pollen may travel, but in the "tail of the distribution" (i.e. at large distances from the GM crop) it becomes much harder to estimate accurately the amount of pollen left. If GM crops are grown on a commercial scale, the background level of pollen will rise, possibly resulting in GM pollen occurring at greater distances than was previously supposed. In particular, "it is still difficult to predict what will happen when GM oilseed rape is grown as a high proportion of the rape crops in a region"[103]. It can be argued however that, were GM food crops being grown on a wide-scale, this would be because there was greater consumer and market acceptance of GM crops and so achieving very low thresholds would have become less of an issue. This argument would not necessarily hold if the widespread production of GM crops was for non-food uses.

94. However, one of the main messages from our technical workshop[104] and the GM science review[105] was that gene flow from pollen transfer would not generally be the main determinant of successful coexistence. The need for separation distances has sometimes been taken as a proxy for the overall need to minimise adventitious presence. We must therefore emphasise that among measures to promote coexistence, crucial as separation distances may be, they would not be the only relevant measure, nor necessarily the most important one, were commercial growing to occur.

95. In Part 2.3 we examine further for specific crops the separation distances that might be expected to be employed to try to keep below the key adventitious presence thresholds.

Volunteer populations

96. Volunteers are - to put it simply - crop plants growing somewhere they are not wanted. This could be GM plants growing in a non-GM crop, or GM or non-GM plants growing elsewhere on the farm.

97. For *oilseed rape*, seed dropped in or around a field when harvesting a GM crop could survive and germinate to become GM volunteers in the next (non-GM) crop in that field or nearby. Research published in October 2003[106] modelled a typical

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[102] Evidence from Professor Perry given at AEBC meeting Edinburgh 11/12 September 2002. http://www.aebc.gov.uk/meetings. Also, Defra monitoring contracts (EPG1/5/84 and EPG1/5/30) on gene flow from GM oilseed rape showed that on occasion cross-pollination levels could exceed 0.5% even at distances of 100-200m (http://www.defra.gov.uk/environment/gm/research/epg-1-5-84.htm); and 'Pollen-mediated movement of herbicide resistance between commercial canola fields' *Science* **296**: 2386-2388, MA Rieger, M Lamond, C Preston, SB Powles and RT Roush, 2002.

[103] *Round Table on Coexistence: Rapporteur's Report on Session2: Oilseed rape.* Jeremy Sweet, NIAB, UK. (http://europa.eu.int/comm/research/biosociety/pdf/rt_oilseed_rape_rapporteurs_%20report.pdf)

[104] Technical workshop at Central Science Laboratories (CSL) York, given to AEBC coexistence subgroup 19 September 2002. http://www.aebc.gov.uk/subgroups/consumer_choicemeetings.

[105] GM Science review, First report, part 7.2.2, p.200.

[106] *Final report of the Defra project: Consequences for Agriculture of the Introduction of Genetically Modified Crops RG0114*, GR Squire and GS Begg, August 2003.

rotation of winter oilseed rape over a period of 18 years. It indicated that after a GM rape crop was grown in a field, a threshold of 1% in a subsequent non-GM oilseed rape crop could only be met within five years if GM volunteers are rigorously managed, with all being destroyed before they set seed. The authors of the research note that "given that impurities also arise through sown seed and by gene flow between fields, thresholds of this order will be difficult to achieve in general farming practice"[107]. If no action was taken, the modelling predicts that the adventitious presence level from the feral plants would take 16 years to fall below 1%[108]. However, farmers would in most cases be expected to be motivated to control volunteers. Outside the cultivated land environment, the establishment and persistence of herbicide tolerant GM feral plants is limited in natural habitats[109], as the herbicide tolerant trait confers no competitive advantage over wild relatives and the rape plants are quickly outcompeted by wild plants.

98. Oilseed rape volunteers (GM or not) require more work to control on organic farms because use of herbicides is not permitted. Mechanical or manual weed removal is used instead. It could be that populations of GM volunteers would appear on organic farms, which could work against minimisation of adventitious presence in organic oilseed rape, if GM cropping had become widespread[110]. However, assuming adventitious presence thresholds remain as they are, there would be a strong motivation for organic farmers to remove such GM volunteers.

99. For *beet*, there would be a problem if bolters[111] were not removed from GM beet and remained to set viable seed, either by self-pollination or via out-crossing with other flowering beet varieties or with their close relative sea beet, producing weed beet which will then set seed in following years, some of which may be viable.

100. Weed beet would need rigorous control in any GM crop production. It can be argued that a farmer with more than a minimal number of weed beet plants in a particular field should not be eligible to purchase GM beet seed to plant in that field; others contend that GM beet could usefully be grown in weed beet infested fields as the only effective treatment for weed beet[112]. Good farming practice requires the removal of weed beet and bolters to prevent any adverse effect on the productivity of the crop and hence its profitability.

101. *Maize.* Volunteers from maize do not occur in the UK because maize does not survive the winter here.

102. *Herbicide tolerance and control of volunteers*. Volunteers are normally controlled by allowing the seed to germinate and then cultivating[113] the field or

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[107] GM volunteers are more likely to occur when land planted with a non-GM crop has previously been planted with a GM crop. It would therefore be important to know the history of particular plots when planning to grow non-GM or organic crops.

[108] The research model used will now be tested in a new project against independent data gathered from field experience on volunteer persistence. Results expected soon of gene flow studies carried out at FSE sites will give further indications of how well collectively volunteer control and other measures worked on a whole-field basis, though not volunteer control specifically.

[109] *Transgenic crops in natural habitats*, Crawley, M. J., Brown, S. L., Hails, R. S., Kohn, D. D. & Rees, M. (2001), Nature 409, 682-683.

[110] This scenario was presented at the European Commission roundtable on coexistence in April 2003.

[111] Growth on the plant which leads to flowering if unchecked.

[112] Farmers at the coexistence workshop supported this second option. In that case the farmer would have to be rigorous in removing any surviving weed beet or bolter from the field and the field margins before flowering.

[113] The farmer's equivalent to the gardener's technique of hoeing.

spraying it with an appropriate herbicide to which the GM volunteer is not tolerant. If a GM variety had crossed with a non-GM variety or with a weed, and the resulting seed germinated as a volunteer in the succeeding crop, that too would require the use of an herbicide to which the GM variety is not tolerant. This could be an agronomic and environmental (rather than a coexistence) problem to some extent for non-GM crop production if the herbicide to which the GM crop is tolerant is the one which a farmer would normally use (for example glyphosate). The farmer would not be in a position to recognise in the first instance that he needed to use a different herbicide, and so might need to spray more than once or decide as a precaution to use more than one herbicide at the outset.

103. A further agronomic problem might develop if more than one form of herbicide tolerance was available in a crop species. This could give rise through cross-pollination to volunteer crop plants or compatible weed varieties which might develop through sequential cross-pollination in succeeding generations ("gene stacking") to produce plants with multiple resistance to herbicides. Other herbicides could be used, but farmers could face problems if this became widespread and in consequence a range of herbicides become redundant in respect of these weeds or volunteers[114]. This may suggest that different GM crops of the same species with differing herbicide tolerances should be separated, as well as GM crops being separated from non-GM crops[115]. For these and other reasons, English Nature has recommended that attention be given to developing gene use restriction technologies (GURTs) to minimise gene flow to wild relatives.[116] An alternative approach could be for ACRE not to recommend for release varieties which could lead to disadvantageous gene stacking in other varieties that have already been released. We disagree on the question of whether herbicide tolerant gene stacking would constitute significant agronomic problems.

Wild populations of crop plants

104. Oilseed rape seed is so small that it can leak through tiny gaps in a farm trailer or lorry, resulting in spillage of seed around the farm or on road side verges that could germinate to lead to feral populations of volunteer plants and risks of cross-pollination with the next season's non-GM oilseed rape crops. Oilseed rape survives more easily in the wild than many other crops, although it is not thought to form persistent populations[117].

105. Avoiding significant loss of the crop during transport is of course in farmers' economic interests. But to minimise the risks, if significant feral populations of suspected GM rape did develop near other crops, then the wild plants should be mown when flowering (i.e. while easy to spot) but before setting seed, to prevent cross-pollination with nearby crops (although this would be at a low rate). Realistically, only individual organic or non-GM farmers would be likely to have a

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[114] *Gene stacking in herbicide tolerant oilseed rape: lessons from the North American experience*. English Nature research reports No 443 (2002). The GM Science review stated that 'Regulators will have to continue to be mindful of the possible consequences of gene-stacking' (p.213). ACRE have stated that they will continue to do so in assessing case-by-case applications for Part C release.

[115] ACRE would take the potential for this type of gene stacking into account when considering granting approval for a new release.

[116] But there are practical and socio-economic difficulties with GURTs: see paragraph 119 of the report.

[117] Crop plants, which have been bred for particular qualities and generally need to be carefully tended if they are to thrive, are generally less adept at surviving in a natural environment than wild plants

sufficient direct interest in doing this, and only then for feral populations relatively close to their farm.

106. Some conventional oilseed rape feral populations exist within pollen distance contact with oilseed rape fields. So feral GM populations which became established following commercial growing of GM crops would be a source of adventitious presence. But because feral populations are small in relation to fields of GM crops, and tend to be outcompeted by wild plants in natural habitats, adventitious presence from feral GM crops would be expected to be at low levels[118].

Gene flow via wild relatives

107. Gene flow via wild relatives seems unlikely to be a major issue *in relation to coexistence.* Were commercial growing of GM crops to occur, hybridisation with wild relatives[119] could potentially lead to the transfer of the transgene into compatible wild relatives and ultimately back into a non-GM crop[120]. Transfer to wild relatives could affect organic farmers whose land might have to be decertified if it had on it plants with a GM content, if such weeds were detected and not removed, and *if* organic certification bodies adopted a policy of decertification in such circumstances. It could also lead to farmers having to be more rigorous in the control of potentially compatible weed species on or close to the farm which might mean incurring some extra costs, but would be compatible with good farming practice. The two principal wild relatives of oilseed rape are wild radish and wild turnip. Sea beet is the only wild relative of cropped beet. Maize has no compatible wild relatives in the UK.

108. Pollen transfer from neighbouring GM crops, volunteers, the seedbank and contaminated seed each seem likely to be more significant causes of adventitious presence than gene flow from wild relatives, so long as the populations of GM hybrids remain relatively small. If they or wild crop populations became significant in size in particular localities then there could be a new need for farmers to eliminate such plants as part of the package of measures to minimise levels of adventitious presence in crops.

Mixing seed or grain

109. Adventitious presence in the crop leaving the farm may be caused if the output from GM crops is inadvertently mixed with the output from non-GM crops. The SCIMAC guidelines set out particular measures which farmers growing GM crops were to follow to minimise this:

- clean all seed drills before and after use for a GM crop

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[118] *Quantifying landscape-scale gene flow in oilseed rape* Defra research project RG0216 (2003), p.41

[119] Oilseed rape can form hybrids with wild turnip, so if GM oilseed rape were commercialised, it similarly would behave similarly. A recent study has indicated the scale of present hybridization. (*Hybridization between Brassica napus and B. rapa on a National Scale in the United Kingdom*, Mike J. Wilkinson, Luisa J. Elliott, Joël Allainguillaume, Michael W. Shaw, Carol Norris, Ruth Welters, Matthew Alexander, Jeremy Sweet, and David C. Mason. Published online October 9 2003 10.1126/science.1088200 (Science Express Reports). The study infers that 'widespread, relatively frequent hybrid formation is inevitable from male-fertile GM rapeseed in the UK. Roughly 1 in 10,000 *B. rapa* plants found in wild populations would be hybrids. 55,426 individual wild relatives of oilseed rape growing in and around FSE oilseed rape plots were tested to determine whether the herbicide tolerant trait had been passed on. No evidence was found that any wild relative had inherited the herbicide tolerant trait. However, the most likely wild relative with which oilseed rape would hybridise - wild turnip (*Brassica rapa)* - was not found growing in or around any of the (limited number) of FSE sites and so could not be tested. (*Gene Flow from Rape Plants in the Farm Scale Evaluations*, C Boffey and R Daniels, CEH, 2003.)

[120] In the case of oilseed rape or (badly managed) beet.

- clean all equipment to be used in harvest before and after use for a GM crop
- clean all storage areas before and after use for a GM crop
- store all GM crops separately from non-GM crops
- inspect all vehicles to be used for transport off the farm both for cleanliness and for security (to prevent leaks)
- throughout, clean up any areas of seed or product spillage
- maintain a full set of records.

PART 2.3 WOULD COEXISTENCE BE PRACTICABLE?

110. Delivering consumer choice were GM crops to be commercialised will depend in large part on practical considerations at the farm level. Having considered the critical control points for adventitious presence on the farm, we considered whether and in what circumstances coexistence might be possible in practice. Our analysis and conclusions about possible ways to deliver coexistence are inevitably provisional, because there are many factors involved and considerable uncertainty about how they would interact and their combined effect on coexistence.

111. As well as flagging up the uncertainties around conclusions on the practicability or otherwise of coexistence, it is important at the outset of our detailed analysis to reiterate that this report does not assume that commercialisation of GM crops will proceed. Banning all commercial production of GM crops in the UK for a set period or permanently would require a renegotiation of the European regulatory framework if the ban was on grounds other than environmental harm or human safety. A ban is the option preferred by some stakeholders. In this report we have examined whether coexistence would be practicable and what the other implications might be were commercial cultivation to proceed.

Something rather than nothing would be needed

112. As a starting point, we are agreed that if commercialisation went ahead, it should not be on a completely *laissez faire* basis i.e. with no measures in place designed to facilitate coexistence. A *laissez faire* approach would meet the criteria of preserving choice, commanding broad support and minimising disputes, only if coexistence could be achieved without any changes to present farming practice.

113. Although it is impossible to be definitive in this, as with other conclusions, it seem probable that introduction of GM crops with no rules requiring specific farming practices might well in time make successful coexistence between GM and other crops impossible for some crops in many circumstances and more difficult for other crops, thus potentially restricting choice for consumers and farmers.

114. It would follow that disputes between farmers would be likely. A *laissez faire* approach would moreover run counter to the general acceptance among most stakeholders, including proponents of GM crops, that if GM crops are grown commercially, it makes sense to introduce them in accordance with best farm management practice, promoting good stewardship of the technology and helping farmers meet market demand for non-GM as well as GM produce. A *laissez faire* approach would also sit strangely with the recognition in forthcoming European regulation that appropriate measures should be taken by Member States to promote coexistence.

115. *Laissez faire* is therefore not a realistic or generally acceptable option. The question is whether any set of arrangements could be expected to deliver coexistence successfully, and to what extent; and whether in view of the uncertainties around the data, we can draw satisfactory conclusions about what might work.

Setting aside less promising possible solutions

116. We set out below a number of possible solutions which we ruled out based on the criteria for considering solutions we set out in Part 1.

117. *Controlling the commercial planting of GM crops through the land use planning system* might initially seem attractive. However, we are advised that present planning law could not be used in this way: once land has been zoned for agricultural purposes, planning law does not control the type of agricultural use made of it[121]. To seek to amend planning law would be an unwieldy and disproportionate solution.

118. *Compulsory regional zoning of GM crops* would be contrary to EU law, except on grounds of a particular environmental risk to the area in question, as the recent Austrian case has highlighted (although the decision is being appealed)[122]. Around ten other European regions, including Wales, and regions in Italy, France and Germany are pressing for the tightest possible coexistence measures, including GM-free zones. Despite the legal ruling a number of UK County Councils and other authorities have as signs of political intent declared their areas 'GM free zones'. Compulsory zoning would significantly limit some farmers' freedom of choice, and it would not be straightforward to operate (requiring the establishment of buffers between zones, and the monitoring of volunteers from long-distance transport of seed and of unauthorised growing within the non-GM zone). Some of us would not rule out the possibility of encouraging voluntary zoning agreements in some circumstances – a possibility recognised in the European Commission's coexistence guidelines. Others of us do not think encouragement would be appropriate: take-up of GM crops and any question of local agreements should be left to the market and local farmers and producers to determine; and compulsory zoning, aside from legal considerations, as an unfair and artificial limitation on access to GM crop technology. Farmers would still be free to make local voluntary agreements arrangements in response to market conditions.

119. *Gene Use Restriction Technologies* (GURTs) could in theory be used to limit cross-pollination from GM crops and GM crop plant volunteers. But technical developmental work in the plant breeding industry has not focussed on using GURTs for the purposes of coexistence. This is due in part to the opprobrium heaped on the suggestion of using such 'terminator' technologies – particularly in relation to developing countries – and the fact that in developed countries, including the UK, there is considerable use of farm-saved seed. UK seed companies accordingly would be expected to face some mistrust from farmers if marketing GM varieties containing GURTs in crops where seed-saving is commonplace[123]. As a technical

[121] In a legal challenge to the FSEs in Scotland, the argument was made that they constituted a change of use of the land from agricultural purposes to research and development: the Court rejected this.

[122] European Commission ruling of 2 October 2003; the regional parliament of Upper Austria announced on 4 November 2003 that it would appeal against the ruling to prevent a ban on GMOs in the region. *Control of GM products in the EU, and the possibility of "GM-free" zones under Article 19 of Directive 2001/18/EC*, Defra, 21 February 2003.

[123] In the UK this includes oilseed rape and wheat.

solution to coexistence, GURTs would probably be some years away, even if there emerged a commercial interest in its development for this purpose[124].

120. *Permitting a higher statutory level of adventitious presence of GM material in non-GM crops* would obviously make coexistence easier to achieve. But for non-GM crops this approach is not achievable within the constraints of EU legislation (where the level for non-GM products is defined) now agreed by the European Council, Parliament and Commission, following long and hard negotiations. Reopening that debate again in the absence of compelling new data from any practical experience of commercial cultivation of GM crops in the EU would seem to have little to recommend it. We discuss the question of self-imposed non-statutory thresholds, particularly 0.1%, below.

Crop management protocols to minimise adventitious presence

121. We have explored whether and how farmers might implement measures to reduce adventitious presence sufficiently to achieve coexistence and preserve consumer choice. The practical measures needed to combat adventitious presence from all these potential causes could be described as crop management 'protocols'. Would following such protocols deliver coexistence?

122. The components of a crop management protocol would include:

- separation distances between GM and other compatible crops, which would be expected to vary from crop to crop, and in some cases between different varieties of crops[125].
- other measures relevant to the crop in question, depending on its particular characteristics (set out in more detail for the FSE crops in Annex C)
- measures common to all crops (e.g. separate storage on the farm, record-keeping, etc).

If protocols were to be a realistic solution to the question of coexistence there would need to be a combination of separation distances and other measures that could be expected to meet the desired threshold for adventitious presence in the vast majority of cases, while not being impracticable for farmers to implement. Separation distances are only one measure to reduce adventitious presence and not always the most important one. Consequently, farmers growing non-GM or organic crops, particularly to thresholds lower than 0.9%, would need to take measures to minimise adventitious presence of GM material in their crops, for example by controlling volunteer plants carefully and cleaning machinery before harvesting crops, as well as the farmer growing the GM crops observing separation distances and taking other measures.

[124]But use of GURTs would be much more likely – indeed might well be a requirement – of any pharmaceutical production using GM plants, where farm-saved seed would not be an issue and outcrossing potentially a health and safety matter as well as a possible negative economic impact on other farmers' crops.

[125] A detailed account of the separation distances used in the FSEs and suggested by the results of recent relevant research can be found in PG Economics Ltd, *Consultancy support for the analysis of the impact of GM crops on UK farm profitability*' (prepared for the Strategy Unit of the Cabinet Office, April 2003: forthcoming UPDATE).

123. There are different views on how different factors would interplay in farm conditions and consequently whether coexistence would be practicable, which we will go on to explore. The Science Review concluded that, "Political decisions, market forces and other pressures will ultimately decide whether coexistence of different farming systems is practical, and in particular what thresholds are set for GM presence in crops and foods labelled non-GM. Uncertainty surrounds the way in which different factors determining coexistence will combine at commercial scales (i.e. the real-life consequences of the combination of unintended presence in seed, cross-pollination, and the contribution of volunteers). For some crops this may be relatively straightforward to manage, for others it may be difficult without significant changes to current practices."[126]

Seeking to meet a threshold of 0.9% for crop production

124. We examined what sort of crop management measures might be expected to be included in protocols to meet a threshold of 0.9% for the three FSE crops, if protocols were developed on the basis of the FSEs and existing data from certified seed production and other relevant agricultural production. The results are set out in table B.

125. Separation distances would need to be set in the light of the best available data and in the light of other factors impinging on gene flow, were protocols to be implemented. Research published in October 2003 on gene flow from GM crops suggested smaller separation distances for GM maize than those in the FSEs[127] and found that the amount of pollen-mediated gene flow in oilseed rape[128] confirmed that relatively small separation distances could reduce impurity through gene flow to less than 0.1% but that, primarily due to the action of insects, 100% purity cannot be maintained by geographical separation[129]. Data on adventitious presence levels from the other FSE crops in addition to that published on maize is expected soon.

TABLE B. POSSIBLE CROP MANAGEMENT MEASURES FOR PROTOCOLS TO MEET A THRESHOLD OF 0.9% FOR THE THREE FSE CROPS.

Beet (sugar and fodder)
Separation distance for crop production
Probably relatively small. The separation distance of 6m in the SCIMAC guidelines for the FSEs was intended simply to allow the operation of farm machinery, not to deal with cross-pollination, because sugar beet is normally harvested before flowering. But separation distances would depend on judgements about how effective bolter and weed beet control on GM plots would be.
Farming measures
• strict control of bolters and weed beet • cleaning of all farm machinery used to sow or harvest the crop

[126] GM Science Review Panel, First Report, p25 (executive summary).
[127] *Monitoring gene flow from GM crops to non-GM equivalent crops in the vicinity. Part 1: Forage Maize* Defra Research Project EPG1/5/138 (2003).
[128] Fully fertile rape, not varietal associations, which the report recommends need specific consideration. And of course, gene flow from pollen, as noted earlier, is only one possible source of adventitious presence.
[129] *Quantifying landscape-scale gene flow in oilseed rape* Defra research project RG0216 (2003).

- separate handling, and storage of GM beet, cleaning GM storage areas afterwards
- cropping interval of 4 years (although if a field is badly infected with weed beet the grower should widen the rotation to 6 or 7 years). More than one year's production of GM beet in a weed beet-infested field should not be permitted and then only when linked to an ongoing eradication programme.
- avoid sowing early (to help to minimise bolters)

Possible additional measure

- beet seed is already sold pelleted and coated. Coating colours could be used to allow GM seeds to be spotted easily if accidentally mixed with a non-GM seed lot.

Oilseed rape

Separation distance for crop production

- For fully fertile oilseed rape, a separation distance of 50m for conventional crop production (more for Varietal Associations[130], where the extent of cross-pollination is uncertain) was employed in the FSEs (for a 1% threshold). Research published in October 2003 found that the amount of pollen-mediated gene flow in oilseed rape[131]in terms of separation confirmed that relatively small separation distances could reduce impurity through gene-flow to less than 0.1%, but due to the action of insects primarily, 100% purity cannot be maintained by geographical separation[132]. Data on gene-flow from cross-pollination from the other FSE crops in addition to that already published on maize is expected soon.

Farming measures

- strict control of volunteers
- cleaning of all farm machinery used to sow or harvest the crop
- separate handling, and storage of GM rape; cleaning GM storage areas afterwards.
- seed spillage on and off the farm carefully monitored
- special care with farm-saved seed

Maize (forage and grain)

Separation distance for crop production

Separation distances of 80 and 130m (for forage and grain maize respectively) were employed in the FSEs (for a 1% threshold). The distances set would depend on the varieties of maize being used. Research carried out during the FSEs suggested that 24.5m would have been sufficient to achieve 0.9% and that 80m was sufficient to ensure cross-pollination levels were below 0.3%, although in a few cases these levels were exceeded at these distances..

Farming measures

- high degree of seed purity needs to be guaranteed
- thorough cleaning of farming machinery
- possible planting of barrier rows to minimise cross-pollination.

[130] Whose use is declining, even in Scotland.

[131] Fully fertile rape, not varietal associations, which the report recommends need specific consideration. And of course, gene-flow from pollen, as noted earlier, is only one possible source of adventitious presence.

[132] *Quantifying landscape-scale gene flow in oilseed rape* Defra research project RG0216 (2003)

126. It seems to us that measures along these lines should be *practicable for farmers growing GM crops to follow*, and that they could reasonably be included as requirements in protocols to be observed as a condition of growing GM crops[133].

127. But while protocols with these measures look practicable to implement for farmers, *would they reliably deliver a 0.9% threshold through time*? If coexistence were to be successful, that would mean that breaches of these thresholds would be rare.

128. There are two aspects to this: is it technically feasible; and would the measures to achieve it be followed in practice with sufficient rigour? There are divergent views among us on both counts.

129. Some stakeholders are confident that protocols would work, because they would build on existing best practice. They cite existing experience in seed production and the production of HEAR rape, and during the FSEs. We have noted the measures in the SCIMAC guidelines and that there was no instance in the four years of the FSEs, which involved some 260 trial sites and 277 organic farms classified by the organic sector as 'at risk', of organic status being lost through adventitious presence. We have also noted that the significance for whether coexistence in commercial production would be practicable of the lack of failures in the FSEs is disputed by some stakeholders. They consider that the various contributing factors of adventitious presence can in principle in most circumstances collectively amount to lower than 0.9% thresholds, providing crop management protocols of the sort outlined above are followed. Many of the measures that would be required of GM farmers in respect of coexistence are in any case being increasingly required in conventional production. The National Farmers Union is confident that a system of protocols could work in principle to facilitate coexistence and recommends this as a way forward[134].

130. Others are more sceptical, even about the 0.9% threshold, because of the lack of experience of growing commodity crops to such a strict threshold, perceptions of experience overseas; and the many uncertainties around how the situation would develop in the field. They also note that for seed production, separation distances are relatively large; and that the tolerances in HEAR production are significantly higher (2%) than the 0.9% threshold. They question whether in fact for 0.9% there is even in principle reliable evidence that the various factors contributing to adventitious presence can cumulatively be kept sufficiently low, at least in some crops.

131. They are moreover not convinced that farmers would follow voluntary protocols sufficiently thoroughly. The farmers' organisation, *farm*, in a submission to the AEBC, cited examples of where voluntary protocols have failed: pesticide over-spray, the need to introduce legislation to prevent straw-burning following the failure

[133] There might need to be separate national protocols for England, Scotland, Wales and Northern Ireland (taking account of any additional cross-border issues in the latter case) to take account of agronomic factors, or there may be political differences on policy on GMs that lead one party to seek more stringent measures. Protocols might also need to allow for relevant regional differences, for example in climate or farming practices (e.g. smaller field sizes in the west of England or the short interval between harvest of one crop and sowing of the next, and use of varietal associations of oilseed rape in Scotland). But they would be broadly similar.

[134] NFU policy statement on coexistence, October 2003, http://www.nfu.org.uk.

of a voluntary code, and sheep dip disposal[135]. Consistent with this view, a recent US Department of Agriculture survey[136] found that almost 20 percent of US farmers surveyed had failed to comply with a regulatory requirement to ensure there are refugia (to prevent build up of insect resistance, not to promote coexistence) around Bt corn fields.

132. They also point to the lack of an adequate economic incentive for the farmer growing GM crops to minimise adventitious presence in their neighbours' crops. Many might do so as good neighbours. But there is no market driver for the farmer growing GM crops to seek to follow crop management protocols rigorously to minimise adventitious presence in other farmers' crops. This is not in itself a fatal criticism of crop management measures but points to a need for protocols for growing GM crops to be mandatory. This would meet the points made about breaches of voluntary protocols.

133. We all agree that in there is considerable uncertainty over what would happen in commercial production. A lot of factors are involved. It would depend on the crop. It would depend on the behaviour of farmers. It would depend on market conditions. Having considered the available information, and recognising the uncertainties noted above, our provisional assessment on balance is that for the first generation of GM crops (oilseed rape, maize and beet), crop management protocols *may* be capable of delivering successful coexistence at 0.9% for maize and beet and perhaps also oilseed rape, but rape would be likely to be more difficult than the other two. But this is very much a provisional view: more evidence is needed of what would happen in practice.

Seeking to meet a threshold of 0.1% for crop production

134. What about the prospects for coexistence at a 0.1% threshold, for those organic and possibly other farmers who expect to work to that level of purity?

135. At present some 4.1% of UK agricultural land is in organic production or in conversion[137]. A report by PG Economics gives the following figures for current organic production in 2002 of the crops which were included in the FSEs:

- Oilseed rape: about 200-250 ha (0.05% of total UK crop)[138];
- Maize: about 500 ha (0.5% of total crop), all forage maize, though in recent years around 40 ha of organic sweetcorn has also been grown[139];
- Sugar beet: 518 ha, which would produce about 3000 tonnes of white sugar (0.3% of total UK sugar production)[140].

136. The lower the level of adventitious presence it is desired to achieve, the less likely it is that any combination of measures can deliver the desired result. With a view to meeting a threshold of 0.1%, we have looked at what degree of certainty

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[135] *farm* evidence to AEBC, May 2003
[136] *Corn and Biotechnology: Special Analysis*, USDA, 11 July 2003 (www.usda.gov/nass/pubs/biocorn.htm)
[137] More than 4000 holdings. Defra statistics.
[138] PG Economics Ltd, *Consultancy support for the analysis of the impact of GM crops on UK farm profitability*' (prepared for the Strategy Unit of the Cabinet Office, April 2003: forthcoming), p61.
[139] *Ibid,* p84.
[140] *Ibid,* p70.

could be achieved by combining the farming measures specified in Table B with more precautionary separation distances.[141]

137. Recognising the need for a combination of measures, the Soil Association has approached the issue through a risk matrix, including separation distances of 1 km for beet, 3 km for maize and 6 km for oilseed rape[142]. These distances are based on a literature survey by the National Pollen Research Unit[143], relating to the distance by which pollen can travel by wind and insect vectors. They would probably pose some difficulties for some farmers who wished to undertake GM cropping, as these radii could encompass a relatively large number of organic fields. The National Pollen Research Unit recommendations are based on "very low risk distances" and not designed to meet a 0.1% threshold as such but rather to seek to avoid any GM adventitious presence.

138. In the FSEs, a lower separation distance (200m) between the GM crop and organic counterparts was set for maize[144] and oilseed rape; this is also the separation distance recommended in a recent Danish study[145]. For beet in the FSEs, the separation distance used in seed production (600m) was adopted[146]; the Danish study recommends 50m as adequate. Other studies, notably the European Commission Joint Research Centre Study[147] suggest that for maize, oilseed rape seed and potatoes, although in some cases existing farming practices would be sufficient to achieve 1%, successful coexistence at 0.1% would be very difficult, and may be virtually impossible to achieve. Research on maize in the FSEs indicated that to get below 0.1% from cross-pollination, 257.7m would be needed[148].

139. A threshold of 0.1% *might* be met quite often, at least initially when GM and organic cropping of compatible crops would be likely to remain limited and because where there was a risk it may often be possible for very local arrangements to be worked out satisfactorily. In the longer-term, it again depends in part on the crop. It would also critically depend on how many non-organic farmers are, in response to market demand, working to 0.1% too. We would expect significantly greater problems in trying to meet a 0.1% threshold than for 0.9% with crop management protocols, particularly for oilseed rape[149] but also for maize; albeit less so for beet, provided there was strict management of GM crops, especially of weed beet and bolters.

140. It is not *certain* that it would always be met even with heavily precautionary separation distances such as those set out by the National Pollen Research Unit,

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[141] Given the main causes of adventitious presence in oilseed rape and beet, rigorous observance of on-farm measures would be more important than separation distances.

[142] PG Economics Report, p118.

[143] Rob Treu and Jean Emberlin, *Pollen dispersal in the crops maize, oilseed rape, potatoes, sugar beet and wheat: evidence from publications*, a report for the Soil Association from the National Pollen Research Institute, January 2000.

[144] The distance for maize takes into account the fact that the maize used in the FSEs (T25) is heterozygous, so only half the pollen carries the GM trait.

[145] Karl Tolsrup et al, *coexistence of genetically modified crops with conventional and organic crops – report from the working group.* Danish Institute of Agricultural Sciences. 10 January 2003.

[146] We understand that this distance related to old varieties which were open pollinators and are no longer used.

[147] *Scenarios for co-existence of genetically modified, conventional and organic crops in European agriculture.* AK Bock, K Lheureux, M Libeau-Dulos, H Nilsagard and E Rodriguez-Cerezo, 2002.

[148] Defra Research project EPG/1/5/138

[149] Although as noted elsewhere, oilseed rape - unlike in conventional arable production - is not at present an important organic crop.

given that adventitious presence from cross-pollination is only one factor and not necessarily the most important. Some of us are very sceptical that this would be a sustainable practically deliverable threshold if GM crops were being grown widely and taking account of the practical difficulties of accurately testing crops to this level on the farm; as we note in Annex B, reliable testing to the 0.1% threshold requires careful adherence to sampling methodologies and would present a significant practical challenge, aside from the issue of the costs of testing.

Seeking to meet thresholds in seed production

141. Maize seed is not produced in the UK. There is some production of oilseed rape seed and a little beet seed is grown.

142. As noted earlier, seed thresholds have not been fixed yet in Europe and are the subject of continued discussion. There is considerable experience of seed production to high standards of purity in the UK, often involving large separation distances. It would be expected that seed production could become more challenging for some crops (particularly oilseed rape) were GM cultivation to become widespread, but GM cropping at this stage would seem unlikely to rule conventional seed production out.

143. Organic seed production to 0.1% thresholds would be expected to prove more challenging – if demand for organic seed for oilseed rape (or some future crops) increased significantly (at present the demand for organic oilseed rape seed could be met easily because the quantity is so small – 0.5 tonnes[150]). Again, if there is market pressure on non-organic farmers to get to a 0.1% or other very low threshold, this could become a bigger problem than one simply for organic farmers.

Seeking to meet a threshold of 0.9% for honey

144. No organic honey is produced in the UK[151], so the relevant threshold for GM content would be 0.9%. The final product would always meet that threshold easily: the actual GM content of honey would be minuscule, because its total pollen content is very small[152]. The issue relates to its ingredients. Because bees forage widely, there is a sense in which all the contents of honey are adventitious – and because it is not feasible to trace the flight of individual bees, there would be no way of knowing the source of the sugar in their honey. Although it has been shown that most of the content of honey comes from within 500m of the hives, bees do range further, up to around five or six miles.

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[150] "Based on 2002 plantings of oilseed rape in the UK (200-250 hectares), the area of seed required to service this is only 0.5 hectares, which could be supplied by one specialist grower (i.e. one field of crop required). It would therefore not be difficult to site such a specialist enterprise in a region where there is limited planting of commercial varieties (e.g. Wales, SW England) and hence minimise the possibility of adventitious presence of GMOs occurring. This siting of specialist seed enterprises in remote areas, to deliver crop isolation and maximise seed purity is not new – it is already applied in conventional seed production, most notably in the potato sector" PG Economics report, p. 37-38.

[151] For reasons unrelated to GMOs.

[152] The Scottish Executive, in its 2003 response to the Health and Care Committee of the Scottish Parliament's report on GM Crop Trials and Health (2003), stated that, "Research carried out on the presence of pollen from GM crops in honey concluded that consumers would ingest no more than 5 nanograms of transgenic protein from a 500g jar of honey - this is one part in a hundred thousand million, equivalent to one crystal of sugar in 28,000 1 kg bags. In 1999, the ACNFP endorsed its earlier advice issued in 1991, that the presence of very small quantities of GM pollen in honey does not present a safety risk to consumers."

145. Faced with a relatively small number of FSE sites, the British Beekeepers Association adopted a policy of a six-mile separation distance of hives from GM trial sites. If GM crops were produced on a commercial scale this might become impracticable in some locations. Beekeepers should be consulted in the design of coexistence arrangements.