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UK and EU policy for approval of pesticides suitable for organic systems: Implications for Wales

A report prepared for the Welsh Assembly Government by

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Executive Summary

Chapter 1. Purpose

- This study was commissioned by the Welsh Assembly Government (WAG) to review the pesticide approval system in the UK and Europe as far as it affects the use of substances and techniques for crop protection by organic producers in Wales.

- WAG considers it important that the UK pesticide approval system does not present unnecessary barriers to the development of organic production in Wales.

Chapter 2. Organic production in Wales – pest and disease management priorities

- From 1998 to 2003, there has been a ten-fold increase in the organic production area in Wales. The current position shows the majority of organic farmland in Wales is permanent pasture, while the proportion of land in temporary grass, arable and vegetable crops is lower than in England. A study in 2003 on horticulture specifically indicated that the area fully converted to organic production in Wales was 394 ha (0.7% of the total area under organic management in Wales).

- Pest and disease control in organic systems relies on a system-based approach, using pesticide interventions only where other approaches are inadequate.

- It has been observed that as organic systems develop, pest and disease management becomes less of a problem. Nevertheless, for key horticultural crops in particular, certain specific pests and diseases can reduce marketable yield. Weeds are more of a husbandry problem in organic systems, however their impact and management is not considered in this study because there are no organically acceptable herbicides, and the methods of control used in organic systems are not subject to pesticide regulatory control.

- A number of crop protection priorities for organic producers in Wales are identified. These are mainly problems associated with potato and vegetable production and include the more common problems encountered in conventional systems. In general, cool ambient temperatures, high rainfall, high humidity and low light levels combine to encourage diseases such as Botrytis, downy mildews and specifically late blight of potatoes. Slugs are also important pests in wet, humid conditions for both outdoor and protected organic crops. Wireworm and leatherjackets are common pests in grassland rotations and aphids are a particular problem in some years. Potato cyst nematode can be a devastating soil borne pest of potatoes particularly where the time period between potato crops is relatively short. For other pests and diseases, consult the body of the report. However, the relatively low density of arable and horticultural cropping areas in Wales reduces the level of disease inoculum and pest populations, which could be an advantage to Welsh organic producers.

Chapter 3. Organic pesticides and biological control

- The approach to pesticide regulation and approval in the EU is outlined. The Pesticides Directive (91/414) is leading to an increasingly harmonised system of regulation and certain 'organically permitted products' are included in the 4th Stage of the Review of the Directive.

- The approval of organic products also depends on their inclusion in Annex 2(b) of the Organic Regulation (2092/91) and on approval for national use under national pesticide regulations. New substances can be introduced, and there is scope for new products that could contribute to improved pest and disease control in organic crops.

- The efficacy of organic pesticides is an important issue, since it may in some cases be relatively low in comparison with a conventional pesticide. However, a direct comparison is not always valid, and appropriate criteria for evaluation need to be taken into account when considering the efficacy of organic pesticides. Whilst there is no minimum level of acceptable control, the main requirement is that the data provided supports the label claim. Label claims could relate to programmes or particular circumstances, so that even if a product used on its own does not warrant a claim of control, it might be acceptable to make a claim such as ''will give control when used as part of a programme with ....' or 'will contribute to control as part of an Integrated Pest Management (IPM) programme'.

- A survey of EU Member States' regulatory bodies showed that there are differences in the availability and development of pesticides suitable for organic production systems. An examination of notifications under the 4th Stage of the Pesticide Directive Review revealed a similar trend.

- The current study sets the UK regulatory policy on organic pesticides in the context of the EU 4th Stage Review and the EU 6th Environmental Action Plan. It also describes various UK initiatives including the UK National Pesticide Strategy proposals and Pesticide Safety Directorate initiatives such as the appointment of a Small Business Champion and a pilot project on the registration of biological products including insect semiochemicals. The Advisory Committee on Pesticides has also commissioned a sub-group on alternative approaches to chemical pesticides. Other initiatives described include the Food Standards Agencies approach to minimising pesticides residues, the Cabinet Office Better Regulation plans for biopesticides and EU, UK and Welsh Organic Action Plans.

Chapter 4. Organic pesticide safety – overview

- The available information on the safety of the organically permitted pesticides is summarised.

Chapter 5. Organic pesticides in Wales

- The potential benefits to Wales from the development of a policy for organic permitted pesticides are outlined under three broad headings: the impact on organic production; an integrated organic policy; and the wider pesticide policy.

- The scope for change is briefly summarised, noting that there is no scope for WAG to approve substances or techniques that fall under national pesticide regulations.

- Proposals are made that will help to ensure that the approval of organically permitted pesticides does not pose an obstacle to organic production.

Key Recommendations and scope for further work

- WAG should work with the Pesticides Safety Directorate to ensure that the development of pesticide regulatory policy at both National and European level takes full account of the needs of both conventional and organic agriculture and horticulture in the UK.

- There is scope for WAG to support the development of a National Pesticide Policy so that regulatory and commercial barriers impeding the development of organic pesticides are minimised. Not only could greater availability of 'organic pesticides' have a significant impact on organic production in Wales but there could be important implications for conventional horticulture systems and the use of alternatives to conventional pesticides.

- One important regulatory barrier to the registration of 'organic pesticides' is the MRL requirement(s) for their approval and this needs to be resolved. Suitable analytical techniques are required to determine firstly whether these substances result in residues, and secondly to identify the breakdown and residue pathways. So far, this issue has not received the attention of any EU Member State.

- According to the proposed framework for the 4th Stage Review of EU Pesticides Directive 91/414, notifiers are required to produce a dossier, at their own expense, covering characterisation, human toxicity, ecotoxicity efficacy and other relevant data. The Review includes specific provision for companies notifying the same substance to submit a shared dossier. This will help those businesses (many of which are relatively small companies) to save on the high cost of producing the dossiers. It will also aid the Commission since it will reduce the number of dossiers that have to be considered, and ensure that all the available data is included. WAG should encourage and support the production of collective dossiers; although as yet there is no indication of how this will be done in practice, and further details from the Commission are awaited.

- This study has concluded that access to a wider range of 'organically acceptable pesticides' would not have a dramatic impact on organic production in Wales.

However, in developing an integrated organic policy, WAG should continue to address the pesticides issue. Some of the methods of pest & disease control in organic systems are either physical or multi-cellular e.g. micro-organisms used as biocontrol agents. WAG agri-environment policy may provide a vehicle to promote these techniques much more actively. Further, it is important to recognise that while Wales alone is too small to have a major impact on commercial and regulatory pressures, WAG can have an impact by working pro-actively with others to make progress.

- There are no published EU or national Member State criteria that can be used to evaluate the acceptability of pesticide substances for organic production. Identifying such criteria and promoting their acceptance at EU level and nationally would allow more active substances to be made available. WAG should work with PSD and others to identify appropriate criteria.

- The specific provisions of Article 7 in Annex 2(b) of the Organic Regulation (2092/91) place potential barriers to the adoption of organically acceptable substances for crop protection. There are a number of potentially useful substances currently not included in the Organic Regulation e.g. potassium bicarbonate. WAG should work with PSD and others to identify such substances and support the production of appropriate dossiers. WAG could also encourage further dialogue between the organic sector and Defra to identify amendments in the Organic Regulations to facilitate the inclusion of new pesticides.

- Organic pest and disease management is not just a question of inputs but it also relies crucially on advice and extension through initiatives such as Farming Connect and the work of Organic Centre Wales. Long-term commitment to supporting on going advice and extension activities is vital to promote and disseminate best practice in Welsh agriculture and horticulture.

- Organic horticulture, vegetable and fruit production systems are particularly sensitive to pest and disease management. Successful control of pests, diseases (and weeds) in these sectors can be critical to the business, and is not assured even when all husbandry and management methods have been effectively applied. Consequently, the use of organically acceptable crop protection methods resulting from future developments (e.g. biopesticides, biological control agents) could have an important role in pest and disease management in these sectors. Both organic and conventional producers in Wales could benefit from having these options available to them and WAG could encourage the adoption of these approaches through appropriate Technology Transfer activities.

- The way in which such substances will be regulated at a European level in future is evolving as the review of the Pesticide Directive 91/414 EEC enters the 4th Stage. This stage of the review includes (amongst others) those substances permitted for use in organic production. The guidance documents for the evaluation of applications on plant protection products made from plants or plant extracts and from chemical substances are currently at the draft stage. The response of the Pesticide Safety Directorate and Defra to these developments is not yet clear but this provides an excellent opportunity for WAG to have an input at an early stage in the review process.

1. Purpose

1.1 Brief

This study was completed to meet the following objectives, specified by the Welsh Assembly Government (WAG):

- Identify the mechanisms within the EU for approval of pesticides.
- Assess the scope for development of different procedures for pesticides suitable for use on organic crops, and the potential benefit of such changes to organic farming in Wales.
- Provide a critical appraisal of progress of Member States and regions regarding implementation of organic agriculture in terms of pesticide policy and highlight any inconsistencies in approach.
- Compare policy and progress in Wales and the UK and assess if changes to EU and UK policy are appropriate to assist development of organic farming in Wales, and consider how these changes could be introduced.
- Identify constraints to any proposed changes, including the over-riding need to ensure the safety of pesticides.

1.2 Intent of the Welsh Assembly Government

The Organic Action Plan for Wales (Anon, 1999) states the aim of 10% of Welsh agricultural production being organic by 2005. WAG continues to develop policies in support of organic farming, and a comprehensive review initiated by the Organic Strategy Group will lead to a new Organic Action Plan for the period 2004 to 2010.

WAG considers it important that the UK pesticide approval system does not present obstacles to the development of organic production in Wales. This study was commissioned to identify opportunities for the development of pesticides and pest control techniques suitable for organic systems; and to investigate the criteria by which such substances are evaluated in the UK compared with conventional pesticides.

WAG wishes to review the scope for alternative approaches to the regulatory process in the UK. This is in line with ongoing work by DEFRA, the Pesticides Safety Directorate and the Advisory Committee on Pesticides, all of whom have been reviewing regulatory issues for alternative approaches, and there are a number of specific initiatives underway. WAG recognises that the primary aim of the UK and European legislation and regulation for pesticides is to ensure that their use does not lead to unacceptable risks to human health, wildlife or the environment.

It is intended that this report will contribute to a review of policy priorities in relation to crop protection for the organic sector in Wales.

2. Organic production in Wales – pest and disease management priorities

2.1 Area and importance of organic production in Wales

The history of organic production in the UK is intimately connected to developments in Wales; from 1970 a number of people established organic farms and holdings in South and West Wales. Horticultural production featured strongly, though not exclusively, on these small scale pioneer holdings which were selling directly to a local customer base (Little & Hitchings, 2003). From these small beginnings, the organic market has grown substantially in the UK as a whole – now representing a market worth £1billion in 2003 (Soil Association, 2003). Wales has been at the forefront of these developments.

The Welsh Organic Industry Working Group, established in 1998 by the then Secretary of State for Wales (Mr Ron Davies), developed an action plan for the organic farming sector in Wales. This aimed for 10% of Welsh agriculture to be organic by 2005. Following the action plan, a number of policy, information and marketing initiatives have contributed to the rapid expansion of the sector.

During the period 1998 to 2003 there has been a greater than ten-fold increase in the organic production area in Wales - from 0.3% (4,073 ha) to 4.0% (54,306 ha) of the Welsh agricultural area. Table 1 shows the land use on organic farms in Wales in 2003 (comparative data for England in 2002 is also shown).

The majority of organic farmland in Wales is permanent pasture, while the proportion of land in temporary grass, arable and vegetable crops is lower than in England

Table 1: Area (ha) of organically managed land (including land in conversion) in Wales and England (December 2002).

Land use	Wales		England	
	Organic land use (ha)	% total organic	Organic land use (ha)	% total organic
Rough grazing & perm pasture	38,576	70.9	73,125	50.5
Temporary ley	10,457	19.2	44,658	30.8
Arable	4,105	7.5	19,143	13.2
Horticulture, potatoes	394*	0.7*	3,633	2.5
Woodland	732	1.3	1,018	0.7
Orchard	*	*	821	0.6
Set-aside	193	0.4	2,533	1.7
Total organic	**54,457**	**100**	**144,931**	**100**

*Orchards included in 'horticulture and potatoes' for Wales.
Green & Haward, (2003) and Defra (2002)

The area under organic management (including both fully certified and land in conversion) in Wales is shown in Table 2.

Table 2: Area (ha) of organic cropping in relation to total cropped areas in Wales (2003).

Crop	Certified Organic (Ha)	In conversion (Ha)	Total Organic (Ha), % of total organic land in (brackets)	Total cropped area in Wales (Ha)	Organic as Proportion of total cropping area (%)
Perm pasture	28,412	10,164	38,576 (70)	1,197,000	3.0
Temp pasture	8,124	2,333	10,457 (19)	136,800	7.6
Cereals	1,648	539	2,187 (4)	45,300	4.8
Other arable	1,687	231	1,918 (3.5)	152,700	1.3
Woodland	538	193	732 (1.3)	285,000	0.2
Vegetables	485	105	590 (1.0)	3,910	15.0
Non crop	180	13	193 (0.4)	No Data	
Set Aside	101	43	144 (0.3)	5,100*	2.8
Fruit	28	12	40 (0.07)	400	10.0
Other	178	87	265 (0.5)	No Data	

Defra, (2003) Eurostat (2003)

In 2003 a study on horticulture specifically (Green & Haward, 2003) concluded that 394 ha were under organic production in Wales. While this is only equivalent to 0.7% of the total organic area (compared to 2.5% in England), it amounts to 10% of the total area of horticultural production, emphasising the relative importance of organics in this sector in Wales. Table 3 shows the areas of individual horticultural crops.

Table 3: Organic horticultural production area (ha) in Wales (2003).

Crop	Total area in organic production (ha)	% of total organic area in Wales
Alliums – Onions	7	2
Alliums – Other	3	1
Brassicas – Cabbage	40	10
Brassicas – Cauliflower	14	3
Brassicas – Broccoli	10	2
Green veg – other	86	22
Roots – Carrots	20	5
Roots – Other	21	5
Potatoes	138	35
Herbs	2	0.5
Propagating	2	0.5
Protected crops	3	1
Salads	11	3
Top Fruit	24	6
Soft Fruit	6	2
Flowers + Ornamentals	7	2
Total	394	

Green & Haward, (2003).

While Welsh organic horticulture has expanded over the past 10 years, the rate of increase in England has been much greater – providing competition to Welsh growers from producers in England with generally better production conditions. Despite this, organic growers in Wales continue to supply significant quantities of produce through all organic market channels. This has been supported in a large measure by a strong supply, packing and distribution base centred on Organic Farm Foods Ltd. in Lampeter, Ceredigion, which, until relatively recently, was the only organic packer for the supermarkets in the UK.

2.2 Pest and disease control in organic systems

In organic production systems, pest and disease management is based primarily on rotation, choice of crop species/variety and other cultural and husbandry practices. To some extent these practices are controlled through organic standards regulated by national certifying bodies and the EU. Weed control is not considered in this study, as there are no organically acceptable herbicides, and the current methods of control used in organic systems (which are mainly mechanical) are not subject to pesticide regulatory control. However, it is important to note that weed management is a high priority for many organic systems, including arable, grassland and vegetable crops. In this report, the term 'pest' is used to refer to invertebrate (insect, nematode) pests. The control of vertebrate pests is not considered as part of the remit of the study.

A review of the various crop protection techniques used in organic systems is provided in Annex 1. The Advisory Committee on Pesticides has also recently produced a report that considers the scope for alternative and non-chemical methods of pest control, many of which are relevant to organic production. This report provides a comprehensive overview of all the available methods (Advisory Committee on Pesticides, 2003). Organic growers need to take a holistic approach to pest and disease management, which considers all aspects of system. For example, good use of well-made composts can have an effect on limiting pest and disease attack in organic crops – leading to a healthy system where recourse to pesticides is not necessary (Tilston *et al.*, 2002; Cheuk *et al.*, 2003; Carisse *et al.*, 2003).

Several surveys on crop protection problems in organic systems have shown that well established systems tend to suffer relatively little from pests, diseases or weeds, with the problems experienced in the conversion period and shortly after tending to be overcome as the system develops (Henry Doubleday Research Association, 2002). On these farms and holdings the grower has built up effective knowledge of local conditions and appropriate husbandry practices over many years.

The use of active substances (a.s.) or biological control methods for pest and disease control in organic systems is restricted to those situations where there is no alternative approach. When interventions become necessary, 'Biorational' approaches (methods of pest and disease control that are consistent with, and often derived from, biological systems) are preferred (Price & Stopes, 2000). These include management of natural predators, biological control methods, and the use of biopesticides derived from natural sources. Some of the permitted a.s are broad spectrum in their control, and may be environmentally disruptive. However, the impact of these potentially adverse effects may be reduced the by the relatively short persistence in the environment in many cases.

It is inevitably the case that a strong advisory and extension service is required to promote best practice and to ensure that effective organic systems and practices are in place for pest and disease management, including appropriate use of allowed inputs. Although this study is focused on regulatory issues, it must be recognised that development and implementation of an effective organic system on farms will depend on advice and extension to encourage best practice. In Wales, this role is currently fulfilled, in the main, by the work of Organic Centre Wales and the Farming Connect organic development programme. This will limit the need for intervention – as encouraged in organic standards – and will ensure that any intervention is as effective as possible.

2.3 Extent of pest and disease problems in Wales

A number of reviews of pest and disease management in organic production in Wales and the UK have been completed (Frost 2003, Gladders *et al.,* 2002; Fraser & Tyson, 1993). From these, several key pest and disease problems can be identified, and are listed in Table 4. A summary of the methods used by organic growers to counteract these problems is outlined in Annex 2.

Pests and diseases in organic arable crops do result in yield loss. However, in general, organic producers do not use any crop protection substances, relying instead on cultural, rotational and husbandry methods of pest management to achieve acceptable levels of control. In the case of grassland, pests and diseases are relatively unimportant, except occasionally during the establishment phase. In both arable and grassland production, slugs can present a considerable problem.

Only occasionally will pest or disease pressure seriously reduce yield or quality in arable crops. In these circumstances, intervention with an organically acceptable pesticide is neither cost effective nor practical. Furthermore, there are no effective substances available to organic arable producers in the UK, although new products and approaches as are available in other European countries (and elsewhere in the world) may provide cost effective solutions for pest and disease control in the future.

In contrast, organic horticulture (vegetable and fruit production) is particularly sensitive to pest and disease management. Successful control of pests, diseases (and weeds) in these sectors can be critical, and is not assured even when all husbandry and management methods have been effectively applied. Consequently, the use of organically acceptable crop protection methods (e.g. organic acceptable biopesticides, biological controls) could have an important role organic vegetable and fruit production.

Table 4: Key pests and diseases of horticultural crops in Wales

Crop	Disease	Pests
Brassicas	Bacterial leaf spot (*Xanthomonas* spp.) Club root (*Plasmodiophora brassicae*), Dark Leaf spot (*Alternaria* spp.) Downy Mildew (*Peronospora parasitica*) Ring spot (*Mycosphaerella brassicicola*);	Aphids (*M. persicae, Brevicorvnae brassicae*) Cabbage root fly (*Delia radicum*) Caterpillars (*Peiris brassicae, P. rapae*) Diamond back moth (*Plutella xylostella*) Flea *beetle (Psylliodes spp).* Slugs
Broad Beans	Chocolate spot (*Botrytis fabae, B. cinerea*) Rust (*Uromyces fabae*);	Aphids (*Aphis fabae*) Pea & Bean weevil (*Sitona* spp) Stem nematode (*Ditylenchus dipsaci*)
Carrot	Alternaria blight (*Alternaria dauci*) Cavity Spot (*Pythium* spp.)	Carrot fly (*Delia radicum*) Cutworm (*Agrostis* spp.) Slugs
Celery	Leaf spot (*Septoria apiicola*)	Carrot fly (*Delia radicum*) Celery fly (*Euleia heraclei*) Slugs
Cucurbits (courgettes, pumpkins)	Powdery mildew (*Erysiphe cichoracearum*)	Aphids (*Myzus persicae*) Slugs Whitefly (*Bemisia tabaci, Trialeurodes vaporariorum*);
Leeks	Rust (*Puccinia allii*)	Cutworm (*Agrostis* spp.) Thrips (*Thrips tabaci*);
Lettuce	Downy Mildew (*Bremia lactucae*), Grey mould (*Botrytis cinerea*)	Aphids (*Nasonovia ribisnigri ,M . persicae, Macrosiphum euphorbiae*) Caterpillars Slugs Whitefly *(Bemisia tabaci, Trialeurodes vaporariorum*)
Onions	Downy Mildew (*Peronospora destructor*), Neck rot (*Botrytis allii*), White rot (*Sclerotium cepivorum*)	Thrips (*Thrips tabaci*).
Potato	Late Blight (*Phytophthora infestans*) Blackleg/ Bacterial soft rot (*Erwinia* spp) Black Scurf (*Rhizoctonia solani*) Common Scab (*Streptomyces scabies*) Spraing (Tobacco Rattle Virus)	Aphids (*Myzus persicae, Macrosiphum euphorbiae*) Slugs Wireworms *(Agriotes* spp) Potato cyst nematode (PCN) (*Globodera pallida)*
Tomato	Potato Late Blight (*Phytophthora infestans*)	Aphids (*Myzus persicae*) Two spotted spider mite (*Tetranychus urticae*) Whitefly (*Bemisia tabaci, Trialeurodes vaporariorum*)

Adapted from Frost (2003), Gladders *et al,* (2002) with additional research.

In Wales, the situation is often made worse since weather conditions are particularly conducive to certain pest and disease problems. Cool ambient temperatures, high rainfall, high humidity and low light levels all combine to make air borne fungal diseases particularly prevalent, whilst crop damage from slugs can be very severe in wet, humid conditions in both outdoor and protected crops. However, Wales does have some advantages in that the relatively low density of horticultural crops, the topography and the Atlantic seaboard mean that producers may benefit to some extent from low background populations of certain key pests by comparison with producers in England.

In some cases, crops otherwise suitable for cultivation in Welsh conditions (e.g. carrots and brassicas) may be subject to attack by particularly damaging pests such as carrot fly and cabbage root fly. Without adequate control of these particular pests, production under organic conditions is not commercially viable since failure to achieve control makes the crop unmarketable. (This is also true of other countries; each region has particular problems potentially making certain crops unsuitable for organic production. Insect pests are generally more of a problem in central and south Europe than in the UK and northern Europe, where fungal and bacterial diseases are more prevalent – although there are exceptions to every rule.)

Organic top and soft fruit growers face particular problems, in part because the permanent cropping system means that crop rotation – a standard organic practice to avoid pest and disease build-up in crops – cannot be implemented. Thus particular effort is made to encourage beneficial organisms such as natural predators for insect pests through habitat management. This means that should pest populations need intervention, a specific, well-targeted pesticide should be used. However, currently approved pesticide active substances permitted under organic standards regulations tend to be broad spectrum in their activity and their use will seriously deplete populations of beneficial insects. Of the diseases, mildews, scab and canker are particularly important in top fruit, whilst soft fruit is subject to damage by mildew, *Botrytis* and bacterial diseases. The active substances available to organic growers are based on copper compounds and sulphur. Although copper is the more effective of the two, its future in organic production is uncertain.

In organic protected cropping, biological control agents are widely used and are an effective means of controlling certain insect pests. These techniques use natural predators and parasites and were originally developed for conventional protected cropping systems for example in tomatoes, cucumbers, peppers. When used correctly, there is usually no need for synthetic insecticides in conventional systems although fungicides are used widely for control of certain diseases.

2.4 Crop protection priorities for organic production in Wales

In the context of the review of pest and disease problems in Wales presented in the previous section, there are a number of priority pest and disease problems where biopesticides and organic acceptable pesticides could contribute to a crop protection strategy. These are listed in Table 5 and are significant in the context of this study because they have a significant economic impact on at least one of the key crops grown in Wales, and /or they cannot be addressed by non-chemical means alone.

Table 5: Priority pest and disease problems in Wales, where organic acceptable pesticides and biological control methods could improve organic crop production

	Pest/ Diseases*	Key Crops affected (as listed in Table 4)
Pests	Aphids	All
	Caterpillars	Brassicas Green vegetables Protected crops Salads. Top fruit (in particular Codling, Tortrix and Winter moths)
	Flea beetle	Root brassicas
	Root fly	Brassicas, carrots
	Slugs	All crops
	Whitefly	Protected crops
)Diseases	*Botrytis spp.*	Most crops (Favours warm, wet, humid conditions).
	Canker	Top fruit
	Powdery/downy mildew	Most crops (These are largely host specific diseases. Powdery mildews favour humid dry conditions, downy mildews favour humid wet conditions)
	Scab	Top fruit
	Rust	Leeks

*see table 4 for species names

The methods of control for problems identified above are summarised in Annex 2. In some cases, substances and techniques not currently available to Welsh growers can be used by organic producers in other EU Member States, and elsewhere in the world, to help control these problems. Organic producers in Wales could benefit from having similar options available to them, as indeed would conventional producers. The way in which such substances will be regulated at a European level in future is evolving as the review of the Pesticide Directive 91/414 EEC enters the 4th Stage. This stage of the review includes (amongst others) those substances permitted for use in organic production. The guidance documents for the evaluation of applications on plant protection products made from plants or plant extracts (Sanco/10472/2003-rev.1) and from chemical substances (Sanco/10473-rev.1) are currently at the draft stage. The response of the Pesticide Safety Directorate and DEFRA to these developments is not yet clear.

3. Pesticides and biological controls

3.1 Regulation and approval

Both existing UK and European pesticide legislation primarily aims to ensure that pesticide use does not lead to unacceptable risks to human health, wildlife or the environment. This is in keeping with government and consumer desire for low risk approaches to pest management including the development of safer more environmentally friendly solutions.

The evaluation of data submitted by companies in support of their applications for approval of products (or with respect to reviews of existing active substances) is a key part of the regulatory and approval process. Data relating to the safety of the consumer, operator and environment as well as information on efficacy is considered. This ensures that minimum standards are met regarding the protection of human health and the environment. All pesticide active substances and microbial controls are included within the regulations. Substances that work by purely physical means and those biological controls based on multi-cellular organisms are not included.

The production and evaluation of safety data is an expensive and time consuming process, the cost of which is recouped when the product is marketed. The money is then reinvested by government through the approvals and regulatory process established in each EU Member State. In the UK, the pesticide levy covers some of the costs of regulation, approval and monitoring of pesticide use. The levy amounts to 3.5% of sales and meets some costs of the Pesticide Safety Directorate and of the surveillance programme reported by the Pesticides Residue Committee.

3.1.1 EU Pesticide Directive (91/414 EEC)

The EU Pesticide Directive 91/414 and national implementing legislation is universally applied throughout the EU. Active substances are included on Annex 1 of the Pesticide Directive following a risk assessment of human and environmental impact and a consideration of resistance management (if appropriate). Specific products (as opposed to the active substance) are subsequently regulated at a national level, where efficacy is more fully considered. At a recent EU Commission Regulator and Stakeholder Review of the Pesticide Directive (91/414), the Commission proposed that products may in future be approved in zones (i.e. Scandinavia, Northern Europe, Southern Europe), rather than at a national level as at present (Nolan, 2004). This would represent a significant change and would have an impact in relation to this study.

The review of pesticide active substances under the EU Pesticides Directive is leading to the gradual harmonisation of pesticide active substance approval and registration processes in the EU. In Great Britain the Directive is implemented through the Plant Protection Product Regulations (1995).

The ongoing and lengthy process of EU review of active substances has resulted in 320 of the almost 900 active substances approved for use in the EU in 1993 being excluded from Annex 1 listing from July 2003. It is predicted that a further 180 will be excluded by 2008, leaving approximately 360 substances. This has already presented a problem for conventional producers, particularly those producing that the major crops. However, because the active substances reviewed to date are not permitted in organic standards, the review has hitherto had no impact on organic producers.

There are two main reasons for an active substance not to be listed on Annex 1. Firstly, current criteria may not be met with the available data, an established unacceptable risk is identified and the active substance is therefore banned. Secondly, the approval holder(s) may choose not to support an active substance. There may be several reasons why this might be the case, but in many cases it may be that cost of generating the data required for the review is cannot commercially justified by sales of that product.

New active substances are continually under development and are coming through the regulatory process all the time. The review and withdrawal from the market of older active substances has stimulated the market for alternatives, including those permitted for organic production. It has also stimulated a wider debate on the need for alternatives and the problems faced by growers. This debate has involved many stakeholders – Pesticide Safety Directorate, the Advisory Committee on Pesticides, the Pesticides Forum, bio-control manufacturers, NGOs, grower organisations, the Horticultural Development Council, research providers and funders.

All stakeholders, not least growers, are increasingly concerned about the dwindling range of products available for pest and disease management. New substances are being considered under increasingly harmonised rules and procedures. However, due to the high cost of development and regulatory approval, only active substances with a very wide field of use i.e. for the major worldwide crops, are likely to be developed. This means that many very important food crops will have relatively few active substances available. It is here that the role for alternative methods, specifically biopesticides and biological control may be greatest.

3.1.2 4th Stage of the EU Pesticide Directive Review

The EU Pesticides Review described above is taking place in four stages. Substances that are permitted under the Organic Regulation (EU 2092/91) are largely included in the 4th Stage of the review, which includes certain food grade substances, plant extracts, microbial biological controls, commodity chemicals and rodenticides. Permitted substances such as copper and sulphur-based fungicides are not included in the 4th Stage of the Review. This stage of the review was initiated in 2002 (PSD, 2002).

The 4th stage has required producers of substances listed in Annex II(a) of the Organic Regulation to notify their interest to the EU Commission according to a defined procedure and timescale. The substances notified are both commercially available and under development. The Commission has produced consolidated lists of notifications provided. A draft Regulation has been made that proposes a framework for review, evaluation and regulation of the specific substances for which notifications were received (Sanco, 2003). There are also procedures for the inclusion of further substances that were not included in the original notification and where there is a pressing need. Draft guidance on the data requirements for these substances has been prepared (Sanco, 2003 a and b). The actual implementation remains to be determined and these draft documents are subject to change.

3.2 Organic pesticides

The 'system' based pest and disease management inherent to organic standards has already been outlined. A limited list of pesticides and biological controls are permitted in organic production standards. Organic producers in the UK can only use substances that both authorised for use by Pesticide Safety Directorate of DEFRA, and listed in Annex II(b) of the EU Organic Regulation (EU 2092/91). The list of authorised substances is reproduced in Annex 3 of this report and includes specific and generic pesticides, biopesticides, biological controls and commodity chemicals.

3.2.1 Approval of organic pesticides

The approval procedures for pesticides suitable for use on organic crops, at least in the UK, are the same as those required for conventional pesticides. These organically acceptable products may have low intrinsic hazard, although this should not be assumed and the evaluation of 'organic pesticides' is made on a case-by-case basis. An overview of the available knowledge on the safety of organic pesticides is included in Table 11 in section 4 of this report. There is a presumption that if a pesticide is approved for use in organic systems, then it is less hazardous than a 'conventional' pesticide. There is no *a priori* reason why this should be so, and it is clearly not the case for some substances permitted for use in organic standards, although it may well be true for others.

The national pesticide regulatory authority has to approve the use of any pesticide substance used by organic producers in every EU Member State, and all must be included in Annex II(b) of the Organic Regulation. During the 4^{th} Stage Review, substances with existing authorisations are permitted to be used until 2008 (Sanco, 2003).

Some Member States already have, or are planning to, introduce alternative lists of substances that are not considered as pesticides. Some, for example, are defined as Plant Strengtheners in Germany, or follow the RUB classification in the Netherlands. Further information is provided in the following Section.

3.2.2 Registration of new substances for organic systems

The development and use of a new generation of natural or naturally derived substances and associated practices is increasingly having wider relevance to conventional production. It is also relevant to organic production provided the substances are included on the limited list in the EU organic regulation (2092/91) and insofar as they are accepted for use by the national organic regulatory authority and the organic certification bodies.

There is a procedure for the introduction of new substances or categories to the permitted list of substances at Annex II(b) of the Organic Regulation through Article 14. This also applies to the other limited lists within the Annexes of the Regulation and there are examples of new substances being put forward for inclusion. An example is given in Annex 6 of the report and shows a dossier for inclusion of Calcium Hydroxide in Annex 2(b) of the Organic Regulation submitted by the Netherlands.

Substances that are acceptable under organic standards may have a limited (though potentially still important) market outside organic farming. Because of the relatively small size of the EU organic market, it is unlikely that a company producing products specifically designed for use on organic crops would be able to recover the costs of development and commercialisation through sales only to organic producers. Despite this, alternative pesticides including those acceptable under organic standards, are commercially available in some EU countries (and elsewhere – USA, Switzerland etc), and the market for these products is presumably wider than to organic producers alone.

The list of permitted substances in the EU Organic Regulation includes both specific and generic pesticides, biopesticides and biological control agents, copper and sulphur based fungicides and insecticides such as pyrethrum where extracted from plant material.

There is considerable scope for extending the current list of permitted substances. However, new substances must be considered from the point of view of both the Organic Regulation (2092/91) and the Pesticides Directive (91/414), including the outcome of the Review as it affects the evaluation and approval of substances permitted for use in organic systems (notably the 4th Stage Review). It is important to note that, amongst other requirements, Article 7(1)(a) of the Organic Regulation requires that new substances to be considered for inclusion on Annex II(a) (i.e. those not already included in Annex II(a)) should satisfy the following conditions:

- They are essential for control of a harmful organism or particular disease for which other biological, cultural, physical or breeding alternatives are not available, and
- The conditions for their use preclude any direct contact with the seed, the crop, crop products or livestock and livestock products; however, in the case of perennial crops, direct contact may take place, but only outside the growing

season of the edible parts (fruits) provided that such application does not indirectly result in the presence of residues of the product in the edible parts, and

- Their use does not result in, or contribute to, unacceptable effects on, or contamination of, the environment.

These conditions are practically difficult (if not impossible) to implement, depending on their interpretation. However, Article 7 does allow that the conditions outlined above shall not apply to products that were in common use according to the codes of practice on organic farming followed in the Community. Some of these may ultimately come under the EU Pesticide Directive, although they may not at present.

There are a number of routes by which a new substance could be considered for approval for use in organic systems. There may also be different tiers of data requirements. Table 6 shows five possible scenarios, each of which has a different potential for exploitation (high, medium or low).

Table 6: Regulatory requirements for consideration of new substances for plant protection in organic systems and the potential for commercial use.

Status of substance	Commercial potential	Requirement
1. On Annex II(b), on 4th Stage review list, commercially available	High	Through 4th Stage Review
2. On Annex II(b), and 4th Stage review list, not commercially available	High	Commercial development, then through 4th Stage Review
3. On Annex II(b), not on 4th Stage review list, not commercially available	Medium	Introduce to 4th Stage list, commercial development
4. Not on Annex II(b), on 4th Stage review list, not commercially available	Low	Introduce to Annex II(b) through Article 14 procedure, meet requirements of Article 7(1)(a) of Organic Regulation 2092/91*, commercial development, then through 4th Stage Review
5. Not on Annex II(b), not on 4th Stage review list, not commercially available	Low	Introduce to Annex II(b) through Article 14 procedure, meet requirements of Article 7(1)(a) of Organic Regulation 2092/91*,introduce to 4th Stage list, commercial development, then through 4th Stage Reiview

* Article 7(1)(a) of the Organic Regulation (2092/91) places specific conditions on new substances not already authorized. See text for further detail.

3.2.3 Criteria for evaluating acceptability of organic pesticides

There are no published EU or national member state criteria that can be used to evaluate the acceptability of pesticide substances for organic production. There are voluntary criteria proposed by the organic sector with both national (Soil Association, 2003) and international relevance (IFOAM, 2002). Safety (human and environmental) are key criteria, other criteria not yet formally considered include the use of co-formulants (adjuvants, stickers, wetters etc), the processing or extraction method used, the source of the raw materials.

Agreed criteria are necessary to enable the development of new substances or techniques, as well as for the review of existing substances permitted for use in organic systems (some of which clearly fall short of any possible criteria). An ongoing Concerted Action project funded by the EU (Organic Inputs Evaluation) is considering the criteria used for both fertilisers and pesticides. The final report is due in 2005 (ORGIN, 2004).

3.2.4 Efficacy of organic pesticides

Organic pesticides may have lower efficacy than products used in conventional systems, and therefore appropriate interpretation of the efficacy results and the assessment of benefits of using the product is required. However, in organic systems more than one approach to pest and disease control is invariably used. Taken together, these may be as effective as a conventional pesticide, or if not, are at least adequate to provide a benefit to the organic producer.

In the UK, the evaluation of an 'organically acceptable pesticide' would be carried out in the same way as for a conventional pesticide, and label claims would be judged against the same criteria. Although there is no minimum level of acceptable control, the main regulatory requirement is that the data support the label claims/recommendations. Label claims could relate to programmes or particular circumstances, so that even if a product used on its own does not warrant a claim of control, it might be acceptable to make a claim such as 'will give control when used as part of a programme with ....' or 'will contribute to control as part of an IPM programme'.

The efficacy of active substances is generally not evaluated for conventional pesticides at a European level (for inclusion on Annex 1 of the Pesticides Directive (91/414)) because it is highly dependent on local conditions, thus a European assessment of any sort would be impractical. Efficacy is assessed in detail when Member States authorise plant protection products. The possibility of zonal product authorisation proposed by the Commission has been referred to earlier (Nolan, 2004). In the UK, extrapolation from areas of similar climatic regions is permitted (visit the following website for details: http://www.pesticides.gov.uk/applicant/registration_guides/efficacy_guides/CPAJUSTfinal.pdf).

The draft Guidance documents (Sanco, 2003 a and b) for the evaluation of substances in the 4th Stage of the Review of the Pesticide Directive (91/414 EEC) are vague but in principle, the Directive currently requires a standard efficacy assessment when these products are authorised by Member States. However, by the time the products under review come up to be re-authorised following Annex I inclusion it is expected that the Directive will have been revised. One of the issues to be considered in this revision are the special procedures for dealing with organic products - so by then there should be a harmonised position (Rob Mason, Pesticides Safety Directorate, pers. comm.).

The European and Mediterranean Plant Protection Organisation (EPPO) has produced guidelines for the evaluation of pesticide efficacy (EPPO, 2000). These include two criteria:

- The product should show results that are significantly superior to those recorded in the untreated control, that are consistent and with a well-defined benefit to the user
- The product should be at least as effective as a reference product, where one is available.

In the case of products suitable for organic systems, comparison with a conventional reference product would be inappropriate, and there may also be no suitable organic permitted reference product. As a result, where specifically organic systems are being considered, it may only be appropriate to evaluate efficacy in relation to an untreated control.

The EPPO (2000) guidelines also include a number of characteristics that could be taken into account where a product has a lower efficacy against the target pest(s). Some of these may be relevant for the evaluation of products for organic systems that may have relatively low direct efficacy. Factors to be considered are:

- Use over a wider range of growth stages of the crop
- Effects against more pest stages
- Lesser influence of climatic factors or soil type
- Greater compatibility with cultural practices or other plant protection measures
- Lower probability of resistance
- Effects against other pests
- Fewer undesirable effects (on beneficial organisms, other crops etc.)

Many organic products are less effective than conventional pesticides because the latter are selected and formulated for their efficacy over a wide range of application conditions. For those products of lower efficacy it is likely that a greater understanding of how a product interacts with the population biology of the pest or growth of the crop may be required. In effect the effort currently devoted into the formulation and discovery of a conventional pesticide may need to be replaced by effort in understanding how to use the organically acceptable product most effectively.

As with conventional pesticides, it would be just as important to understand when it is not worth applying a particular product as much as identifying those situations when a benefit is likely to result. Also (as reported in Advisory Committee on Pesticides (2003)) in all cases, whether for efficacy or other assessments required for the regulation of pesticide alternatives, it is important that the scientific integrity of these assessments is maintained. The design of experiments to test the efficacy of organic pesticide active substances is likely to be more demanding than for conventional pesticides which are more active.

3.3 EU Member State regulation of pesticides suitable for organic production systems

Although all EU Member States are implementing a common Pesticides Directive, its interpretation in different member states, the level of commercial development, past use of substances and the overall regulatory position vary enormously. Consequently there are significant differences between countries in the availability and use of many of the permitted substances for crop protection listed in Annex II(b) of the Organic Regulation.

Germany and the Netherlands have introduced positive lists of substances that are not regulated as pesticides. The Plant Strengtheners list in Germany (BVL, 2002) was drawn up by the national regulatory authority (Federal Office of Consumer Protection and Plant Safety - BVL) to include a wide range of substances not considered as pesticides, rather as substances that enhance resistance or protect plants. In total 220 substances are included on the list, representing a very wide range of materials, with a varied and largely unknown effect. Some might be considered as pesticides by other regulatory authorities. Inclusion on the list requires a fee of 290 Euros and takes four months. Organic certification bodies are responsible for specific authorisations under their inspection and verification programme.

In the Netherlands, a shorter list (Regulation for Exemption of Pesticides known as the RUB list) has been drawn up to include substances that have a low risk profile and can be regarded as safe. This list has allowed 'low risk' substances (including sand, garlic, milk, beer, alcohol) that are not registered as plant protection products to be approved for use. The Netherlands Ministry of Agriculture decides on inclusion, not the pesticide regulatory authority[1]. Similar provisions are being drawn up in both Spain and Italy.

These approaches are clearly mechanisms devised to avoid the current EU pesticides regulatory process and to facilitate organic pesticide approval. It is understood that these approaches have little sympathy within the EU Commission, although they do increase the availability and use of a wider range of substances suitable for organic production systems in these Member States (van Boxem, Commission DG Agriculture, pers comm.).

Two approaches have been used in this study to evaluate the differences between EU Member States in their approach to the regulation of pesticides suitable for organic production systems:

- A survey of EU regulatory authorities was initiated to identify key issues and to draw up a list of permitted products.
- Evaluation of notifications in the 4th Stage of the Pesticide Directive Review

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1 Source:http://vti28.vertis.nl/pls/portal/docs/PAGE/WEBSITE_CTB/BESTRIJDINGSMIDDELEN_EN_WERKZAME_STOFFEN/04OVERZICHT_TOELATINGEN_RUB/LIJST%20RUB.DOC

3.3.1 Survey of EU regulatory authorities

The regulatory authorities in ten EU Member States were contacted by e-mail with a questionnaire (see Annex 4) concerning the current regulatory position of the various substances permitted under the Organic Regulation in each country.

An acceptable response from all those contacted was not achieved (see Table 7), despite repeated follow-up contacts. Initially it was found that some of the contacts provided by the Pesticides Safety Directorate were incorrect, or had the wrong e-mail address. Delays over Christmas 2003 were predicted, however the failure to get a promise of completed questionnaires during January was disappointing.

Table 7: Member states included in survey and responses.

Member State	Initial Response	Follow up response	Final Status
As tender			
Austria	None	Yes – no promise	None
Denmark	Will not complete	Need new contact?	None
France	Wrong contact	Got right contact. Promised mid-Feb	None
Germany	None	Yes – no promise	OK
Great Britain	Promised	Promised	OK
Ireland	Complete		OK
Italy	None	Yes – wrong contact? Need new contact.	None
Netherlands	Promised	Promised	OK
Sweden	Complete		OK
Spain	None	Yes - promised	None
Additional			
Belgium	None	No	None
Finland	None	No	None
Greece	Complete		OK
Luxembourg	None	No	None
Portugal	None	No	None

A comprehensive assessment of the situation in all member states included in the survey was not possible. However, the responses available provided a limited indication of the current position with regard to the regulation and approval of pesticides permitted in the Organic Regulation. Table 8 outlines the current position. The survey also included questions on the type and availability of organic permitted substances, and these are summarised in Table 9.

Table 8: Regulatory requirements for approval of pesticides permitted in EU Organic Regulations in various EU Member States.

Regulatory factor	UK	Netherlands	Germany	Sweden	Ireland	Greece
Organic permitted substances commercially available	Yes	Yes	Yes	Yes	Yes	Yes
Evaluation by regulator	Yes	Yes	Yes	Yes	No	Yes
Human safety data & evaluation	Same as for all pesticide		Same as for all pesticides	Same as for all pesticides	Same as for all pesticides	Basic tox data, including acute, short and chronic
Environment safety data & evaluation	Same as for all pesticide		Same as for all pesticides	Same as for all pesticides	Same as for all pesticides	Few data on eco-tox required (e.g. acute toxicity to bees)
Use of 'reasoned argument' acceptable	Reasoned arguments can be accepted in place of data, where appropriate.		In accordance with Directive 91/414/EEC	Yes for many, with justification accepted by National Chemical Inspectorate. Thus in practice full data & evaluation not required	Same as for all pesticides.	Yes, in some cases if well substantiated
Efficacy requirements for organic pesticides	No distinction is made. All products are required to be regulated under UK pesticide legislation are evaluated in the same way. The key criteria for efficacy evaluation is how the efficacy claimed relates to the label claims		In accordance with Directive 91/414/EEC	Efficacy requirements the same for all pesticides	Same as for all pesticides	Standard efficacy data required. In some cases efficacy data from other countries accepted
Annex II(b) substances not sold as plant protection products	None known			Some. A chemical may be used as a pesticide provided use does not cause danger to humans or environment	Not known	Not known
Regional regulation	No	No	No	No	No	No
Pesticide Directive (91/414) appropriate to organic or non-conventional active substances?	Yes		Yes (in absence of agreed directives/ guidelines)	Yes	Yes	Yes, but there is a need for amendments to give flexibility in data requirements for authorization of products falling into the category of "low risk"

Table 9: Availability of Substances permitted for plant protection in organic production in the EU

Substance	UK	Netherlands	Germany	Sweden	Ireland	Greece
Azadirachtin	No	Yes – 1 product	Yes – 2 products	Yes – 3 products	No	Yes – 1 product
Beeswax	No	Yes (exempted from regulations)	No	No	No	No
Gelatine	No	No	No	No	No	No
Hydrolised proteins	No	No	No	No	No	Yes
Lecithin	No	Yes (exempted)	Yes – 1 product	No	No	No
Nicotine	Yes – 6 products[3]	No	No	No	Yes – 1 product	No
Plant oils	No	Yes (some exempted	No	Yes – 3 products	No	No
Pyrethrins	No	Yes – 5 products	Yes - 21 products	Yes – 13 products	Yes – 11 products	Yes – 1 product
Quassia	No	No	No	No	Yes - 1 product	No
Rotenone	Yes – 2 products[3]	No	No	No	Yes – 2 products	Yes – 1 product
Micro-organisms	Yes – 1 product	Yes – 15 products	Yes – 11 products	Yes – 8 products[1]	No	Yes – several
Diammonium phosphate	No	No	?	No	No	No
Metaldehyde	Yes – 45 products	Yes – 10 products	Yes – 9 products	No	No	Yes – 1 product
Pheromones	No	Yes – 3 products	Yes – 5 products	No	No	Yes – several
Pyrethroids (in traps)	?	Yes - 41 products but use not clear	No	No	No	Yes
Copper based	Yes – 4 products	No	Yes – 10 products	No	Yes – 2 products	Yes – several
Fatty acid K salt soft soap	Yes – 2 products	Yes – soap exempted. K-fatty acids authorised	Yes – 2 products	Yes[2]	Yes – 7 products	Yes – 1 product
Lime sulphur	No	No	?	Yes	No	Yes – 1 product
Paraffin oil	No	No	Yes -	Yes[2]	No	Yes – 1 product
Mineral oils	No	Yes	Yes – 10 products	Yes[2]	No	No
Potassium permanganate	No	No	?	No	No	No
Quartz sand	N/A	Yes – exempted	No	Yes[2]	No	No
Sulphur	Yes – 20 products	Yes – regular & special exemptions	Yes – 12 Products	No	Yes – 4 products	Yes – 1 product

1. Also 65 multicellular biological control agents using insects, mites and nematodes. These are not regulated under pesticide regulations and In the UK are subject to approval by the Advisory Committee on Releases into the Environment (ACRE).
2. These are considered to work by physical means – not regulated as pesticides.
3. Not necessarily aqueous extracts or extracted from the plant material specified in Regulation 2092/91 EEC

3.3.2 Evaluation of notifications in the 4th Stage of the Pesticide Directive Review

The status of alternative products in EU Member States can be deduced from the notification of substances under the 4th Stage review of the Pesticides Directive (91/414) and included in the draft regulation. Annex 5 includes the detailed breakdown of all the substances notified through this process from 13 member states. Table 10 summarises for each country the number of products (total and excluding pheromones) notified in each of the categories and types of active substance that are permitted under the Organic Regulation 2092/91.

In total, 257 relevant products have been notified under the 4th Stage Review, not all of have been notified as pesticides, some have been included as repellents (see Annex 5: all the pheromone products and 22 others – a total of 94 individual product notifications). The majority of the 257 products are plant extracts (108), followed by attractants (77) – mostly pheromones. Of the plant extract based products notified, 38 are the 'traditional' plant based insecticides (Azadirachtin, Nicotine, Pyrethrins, Quassia and Rotenone) whilst 53 products notified represent plant oils from 19 different plants.

There is considerable variation between countries in the number of notifications; two member states have made no notifications. Italy has the most (45 or 17%), whilst Netherlands, France, Germany and Spain have all made over 30 notifications. Between them, these five countries represent over 75% of all notifications. Great Britain is ranked sixth.

There are also notable differences in the types of product with notifications, the Netherlands has notified the most pheromone products, whilst Spain records the most plant extract based products. The majority (15 or 68%) of products notified by Great Britain are plant extracts and five of these are notified as repellents.

Although it should not be assumed that a wide range of products is all commercially available, many are. Also, the process of notification has not required the notifier to indicate the field of use of the substance or product. That said, the fact that there is an apparently extensive list of substances that may be appropriate suggests that further evaluation of these is required. Key categories of interest to UK organic production are the plant extracts (particularly the oils and other non-traditional insecticide substances), the pheromones and micro-organisms. In all three cases, particularly pheromones and micro-organisms, there are examples where both organic and (quantitatively more importantly) conventional producers would be likely to benefit.

Table 10: Notifications under 4th Stage Review by EU Member States in five categories (for full list see Annex 5 of this report)

Country	Total No. of products	No. excluding pheromones	Part A			Part B	Part C
			Foodstuffs [1]	Plant extracts	Commodity substances	Attractants repellants (inc Pheromones)	Microorganisms
Austria	10	2	0	1	0	9	0
Belgium	6	5	0	1	0	1	4
Germany	36	28	5	13	4	11	3
Spain	33	26	2	19	0	7	5
Netherlands	42	19	1	13	1	24	3
France	38	26	0	18	0	12	8
Ireland	2	2	0	2	0	0	0
Italy	45	39	3	18	2	6	16
Denmark	3	3	2	1	0	0	0
Great Britain	22	22	6	15	0	0	1
Greece	9	4	1	0	1	5	2
Sweden	8	6	0	6	0	2	0
Finland	3	3	0	1	0	0	2
TOTAL	257	185	20	108	8	77	44

1 Only including Fatty Acids Potassium salt as specified in Organic Regulation 2092/91. Eight other fatty acids are listed in the notifications, however, these have not been included in this summary.

3.4 UK Policy context

Any proposals that affect the regulation of pesticides suitable for use in organic production systems should take account of ongoing and sometimes complementary initiatives both in the EU and in the UK.

The various policy initiatives are briefly described below and an outline timetable for their completion is provided in Annex 7.

3.4.1 EU Pesticides Directive 91/414 Review

The Plant Protection Products Directive (91/414/EEC) was adopted by the Council of Ministers on 15 July 1991 and published on 19 August 1991 (OJ L230, ISSN 0378 6978). It came into force on 26 July 1993 and is implemented in the UK by the Plant Protection Products Regulations 1995 (as amended). A major part of the Directive provided for the review of existing 834 substances on the market in EU market in 1993 and were divided into four lists. The first list was due to be reviewed by July 2003, the second list by 2005 and the third and fourth lists by 2008.

The Regulation for the Fourth Stage of the EC review programme was published in June 2002. (European Commission, 2002). This stage picks up a more diverse range of products and uses than the mainstream pesticides covered by the earlier stages of the review. It includes substances such as plant and animal extracts, attractants and repellents (including pheromones), micro-organisms, rodenticides and mole control agents, and pesticides for use on stored plant products.

The following commodity substances currently approved for agricultural uses in the UK also fall in this fourth stage review process: carbon dioxide, formaldehyde, paraffin oil, sodium chloride, sodium hypochlorite, strychnine, sulphuric acid and urea. These substances have been divided into two lists as detailed in Annex I and Annex II of the Regulation.

3.4.2 EU Thematic Strategy and the EU 6th Environmental Action Plan

On 1 July 2002, the European Commission adopted a Communication 'Towards a Thematic Strategy on the Sustainable Use of Pesticides' (European Commission DG Environment, 2002). The Communication follows the mandate given by the European Parliament and the Council in the framework of the 6th Environmental Action Programme (6EAP).

The Communication is mainly based on the results of a two-phase study programme conducted in co-operation with the Dutch authorities since 1992. Recent reports complemented the basic analysis work for this communication.

The Communication contains a detailed description of the current situation regarding pesticides and related areas, both at Community and Member State level, and identifies and analyses a number of objectives and possible solutions:

- Minimising the hazards and risks to health and environment from the use of pesticides through national plans for reduction of hazards, risks and dependence on chemical control
- Improved controls on the use and distribution of pesticides
- Application of the substitution principle
- Encouraging low-input or pesticide-free crop production
- Feed-back mechanisms and indicators to evaluate progress: reports by Member States on risk reduction programmes, quantitative targets, OECD work on harmonisation of indicators.

3.4.3 UK National Pesticides Strategy (Defra, Pesticide Safety Directorate)

The proposal that the Pesticide Safety Directorate should develop a national pesticides strategy arose because of two recent developments (Pesticide Forum, 2003):

- The European Commission statement on the sustainable use of pesticides (see above) that envisages a community strategy that will give considerable emphasis to national plans. These would set out how individual member states will reduce hazards, risks and dependence on chemical pesticide use in agriculture

- The House of Commons Environmental Audit Committee in its report on the Voluntary Initiative (as an alternative to a pesticides tax) called on the government to develop and publish a pesticides strategy as a matter of urgency. The strategy should show how different policy instruments would be used to complement each other and achieve a reduction in the environmental impacts of pesticides.

As yet, the National Pesticides Strategy remains in draft form, but will almost certainly be guided by the requirements being developed in the EU thematic Strategy (see above).

3.4.4 PSD Small Business Champion

During 2003 the Pesticide Safety Directorate recruited a 'Small Business Champion (SBC)' as recognition of the fact that many small and medium sized enterprises predominate in the development and production of alternatives to conventional pesticides.

The regulatory process within the UK and Europe as a whole is changing fast and presents everyone, but especially small businesses, with many challenges. The smaller business frequently has very specific and individual requirements and the SBC post has been established to give PSD the flexibility to meet those requirements.

Although the remit of this post will be customer driven at the outset it is envisaged that the SBC will offer a spectrum of services to small businesses. These will range from introductory presentations and one-on-one advice (e.g. advice on the completion of appropriate documentation), to acting as a sounding board to talk through future projects. (Pesticide Safety Directorate, 2003)

3.4.5 PSD pilot project on registration of biological products

When registering pesticides, the Pesticide Safety Directorate is required to recover the full cost of registration from the pesticides industry. As a result, the same charges are levied for evaluating the application dossiers of biological products as for conventional pesticides. These charges are high at £44,700 for each dossier compared with other EU countries where the fee is in the order of €20,000 (approx. £13,600). However, PSD has recently announced a pilot scheme that has reduced the cost of registering pheromones, biological and plant extract based products (see also Cabinet Office BRT initiative below).

3.4.6 PSD research on regulation of pheromone products

The Pesticide Safety Directorate has also commissioned Rothamsted Research Centre to carry out a detailed study on the registration of three pheromones.

3.4.7 Advisory Committee on Pesticides sub-group report: Alternative approaches to chemical pesticides

In 2003 the Advisory Committee on Pesticides established a sub-group to investigate the prospects for developing alternatives to pesticides in the UK. The report was discussed at an ACP Open Meeting in October 2003.

The remit of the sub-group was to consider and report on:

- The problems of pest control in British agriculture that are likely to result from changes that are occurring in the availability of pesticides.
- The opportunities to counter these problems by encouraging the development of alternative methods of pest control both chemical and non-chemical.
- The scope more generally for effective alternatives to chemical control of agricultural pests.

The report recognised that while there are a number of difficulties in developing alternatives to pesticides, many of these alternative methods are viewed favourably by large sections of the general public, and therefore this presents a strong argument for their development and wide usage. However, from the farmers' and retailers' point of view their benefits are less certain. Their efficacy is often lower than conventional pesticides, and they are more variable in effect than conventional pesticide sprays (Advisory Committee on Pesticides, 2003).

3.4.8 FSA residue minimisation policy

In June 2003, the Food Standards Agency Board agreed to adopt a commitment to minimising pesticide residues in food. Five crops were identified during a stakeholder consultation process (cereals, apples and pears, potatoes and tomatoes) as sectors where action plans could be developed to reduce residues in these crops. Each sector presents its own particular challenges that will determine the potential for residue reduction. However, if successful, they will provide a range of experiences that may then be applied to other areas. For each crop, a detailed action plan will be drawn up in consultation with the key stakeholders. It will establish a baseline against which to measure progress, and a list of actions to be taken with a timetable for achieving them. If the Board agrees to this proposed approach, these plans will be developed for further consideration by the Board in December 2003 [subsequently delayed into 2004] (Food Standards Agency, 2003).

3.4.9 Cabinet Office Better Regulation biopesticide engagement

The Business Regulation Team (BRT) of the Cabinet Office became aware of the developing bio-pesticide market during its work with parts of the chemicals sector in 2002. After consulting with a wide range of business and other stakeholder groups, the BRT discovered that, although Defra had been funding the research and development of 'alternatives' to synthetic pesticides, none had been able to obtain the authorisation required for such products to be placed on sale in the UK as plant protection products.

Further investigation revealed that the EU regulations (EC Directive 91/414) require national regulatory authorities (PSD in the UK) to ensure that proper testing of product toxicity and efficacy is carried out. However, these testing requirements and allied procedures were developed for the regulation of synthetic chemical pesticides. Synthetic pesticides are developed to deliver a consistent and much higher degree of pest control compared with alternatives. They often have worldwide applications and markets and consequently, the costs involved in providing a regulatory dossier had not proved a barrier to their development. The alternative pesticides sector is invariably populated by small and medium sized enterprises, typically with limited venture capital available and little by way of an income stream. The costs associated with the development of a registration package for these are often prohibitive.

Having identified what appeared to be an interesting example of regulation-inspired market failure, the BRT approached the Pesticides Safety Directorate seeking help to establish a workable solution to the problem. Significantly, PSD was committed through its 2003-2006 business plan to encourage the development and introduction of 'alternative' control measures, so was keen to discuss ways in which the pursuit of this new aim could be promoted. As a result, PSD agreed to launch a pilot scheme to investigate the best practice for processing applications for bio-pesticides scheme (see 3.4.5 above).

The aims of the pilot scheme are threefold: to assist companies in compiling reduced data packages by providing free 'pre-submission' meetings; to enable alternative products (subject to evaluation) to enter the market; and to provide PSD with experience in processing these types of applications and to consider an appropriate changing structure. (Cabinet Office, 2004)

3.4.10 European Action Plan for Organic Food and Farming

The Commission is currently preparing a European Action Plan for organic food and farming that will contain proposals for future initiatives aimed at enhancing the further development of the organic farming sector. In December 2002, a working document entitled "Analysis of the possibility of a European Action Plan for organic food and farming" was prepared. The paper analyses the current position in the development organic farming in Europe and lists possible elements for actions to be included in the final Action Plan.

In June 2003, the European Parliament held a hearing on organic farming where the Action Plan was discussed and subsequently, on 22 January 2004, the Commission organised a hearing in Brussels. More than 100 organisations, Agricultural Ministers from Member States, Acceding and Candidate Countries and farmer magazines were invited to participate.

In early 2004, the Commission will prepare the final Action Plan in the form of a Communication to the Council and the European Parliament. The Plan will propose actions to facilitate the further development of organic farming (European Commission, 2004).

3.4.11 UK Organic Action Plans

Over the last 5 years Organic Action Plans have been developed for Wales, Scotland and England. Wales was the first to publish such a plan in 1999 (Anon 1999), with aim of converting 10% of agricultural and horticultural production by 2005. This was to achieved through an integrated approach encompassing three main strands of activity:

- Policy initiatives (including the Organic Farming Scheme and the recently announced organic maintenance payments)
- Support for the marketing of organic produce (mainly through the Welsh Development Agency).
- Information and knowledge transfer activities (including the establishment of Organic Centre Wales and the Farming Connect Organic Development Programme)

A second action plan for Wales, covering the period 2006 – 2010 is close to completion and is expected in summer 2004.

The English action plan (DEFRA, 2002a), published in 2002 similarly aims to more than double the proportion of UK grown organic food. As in Wales, political support for the plan is through the Organic Farming Scheme and Maintenance payments (although the rates for the latter are slightly lower than for Wales).

These Action Plans are the first step in a continuing process. The Government and the devolved administrations are committed to progress a number of other associated key issues, including the role of small abattoirs, increasing exports of UK-produced organic food, and more organic fruit and vegetables in the British diet.

Proposals for new ‘Entry Level’ Agri-environment schemes are being developed in England and Wales that could include an organic ‘strand’, which will achieve better integration of the OFS with other Agri-environment Schemes.

4. Organic pesticide safety - overview

It is important that the use of pesticides in organic production does not lead to an unacceptable risk of harm to health or the environment. Thus it is necessary to evaluate the available information on the safety of the pesticides permitted in organic production. Where there are data gaps, further evidence may be required, depending on the possible hazard or risk (as defined in box below), and the extent to which a 'reasoned argument' can be made from other evidence.

Assessing pesticide safety: Definitions and key concepts:

HAZARD is the potential to cause an adverse reaction (and reflects the innate properties of a substance). This is usually measured in terms of the toxicity or potential for persistence or bioaccumulation of a substance. The **RISK** associated with the use of a substance is defined by both the exposure and the hazard taken TOGETHER. A low toxicity coupled to an high exposure leads to a low risk of adverse effects, whereas a low exposure to a highly toxic substance could lead to an unacceptable effect.

Characterisation of exposure is therefore very important. Firstly, it is necessary to determine if usage leads to exposure, and then if the properties of the compound lead to a risk of adverse effects. It follows that where there is no exposure, there is a very low risk even if the toxicity of a substance is very high.

The Pesticide Action Network (PAN) database (www.pesticideinfo.org) contains comprehensive hazard data on pesticides, recognised by regulators and other competent authorities. 'PAN Bad Actors' are chemicals that are one or more of the following:

- highly acutely toxic
- cholinesterase inhibitor
- known/probable carcinogen
- known groundwater pollutant
- known reproductive or developmental toxicant

Annex 8 summarises the health and environmental impacts of pesticides used in organic farming and all the chemicals listed have been through the PAN database. It contains one 'PAN Bad Actor' – pyrethrins, because they are considered to be human carcinogens. Lambdacyhalothrin is considered a potential endocrine disruptor, although this category does not qualify it as a 'Bad Actor' because there are currently no authoritative regulatory lists of endocrine disruptor chemicals.

Other active substances such as rotenone, deltamethrin, and metaldehyde, are rated as moderately toxic, and the Californian Environment Protection Agency also considers metaldehyde a potential threat to groundwater.

The majority of chemicals that are cited in Annex 8 as ‘No adverse effects listed’ raise no serious hazard criteria issues, according to the PAN database and the BioPesticide Manual, a world compendium produced by the British Crop Protection Council (Copping, 2003). However, very few studies have been carried out on them in the same way they have for conventional synthetic pesticides. Most of these chemicals are assumed to be of low acute toxicity because they are naturally derived, and readily break down in the environment, therefore having low persistence and low bio-accumulation. However, there is virtually no information about the potential chronic effects of these chemicals, in relation to carcinogenicity, mutagenicity or reproductive toxicity.

Some of these substances (although by no means all) are ‘ubiquitous’ or have been widely used, and as such, humans have been exposed for many years, or in some cases for generations with no severe adverse outcomes for human health, wildlife and the wider environment detected. This provides reassurance, in some cases, of their relative safety.

5. Organic pesticides in Wales

5.1 Potential benefit to Wales

The potential benefits should be considered in the context of:

- Impact on organic production
- Integrated organic policy
- Wider pesticide policy

5.1.1 Impact on organic production

The crop protection priorities for organic production in Wales are summarised in Section 2.1 and Table 5. The priorities are universally in horticulture, vegetable and fruit crops, with both insect pests and fungal diseases important. Weeds are not included in this assessment because there are no realistic biopesticide alternatives. Although the extent of horticultural, vegetable and fruit production is relatively small in Wales (394 ha), with a farm-gate value of £1.8 million (*Green & Haward,* 2003), it is an important part of the Welsh organic sector, and represents 10% of the total Welsh horticultural area.

It is likely that organic crop production would be improved if the priority pest and disease problems were better alleviated through a combination of best organic practice (cultural, varietal and husbandry methods of pest and disease management) with the judicious use of interventions using organic acceptable substances, biopesticides and biological controls where problems are intractable. Only part of the solution involves improving the availability of permitted pesticides (in the broadest sense). A whole system integrated approach is vital and is only achieved by effective technology transfer through advisory and extension services. The observation that the extent of pest and disease problems on organic farms declines as farmers and growers become more experienced emphasises the importance of a whole system approach.

Although it is not possible to quantify the benefit of a greater availability of organic permitted pesticides and biological controls from the available information, it would seem reasonable to assume that organic horticulture, vegetable and fruit production would be more profitable if the ability to control key pests and diseases were improved. This would not only enhance the performance of existing producers, but could also encourage further uptake of organic horticulture, vegetable and fruit production in Wales as part of the organic system on existing and new enterprises.

The limited range of organic permitted products available to organic producers in the UK is a constraint to the control of certain pests and diseases. Table 11 summarises the organic crops where products (commercially available and near market) in other EU member states (as identified through this study) might provide adequate levels of control of relevant pests and diseases under Welsh organic conditions.

Table 11: Pests and diseases on organic crops in Wales where alternative pest and disease control methods might provide control

Pest/disease	Crop	Technique*	Potential
Caterpillars	Top fruit, brassicas, green vegetables, protected crops, salads	Pheromone, commodity chemical, plant extract	Medium
Root fly	Carrot, brassicas	Plant extract	Medium
Aphids	All	Soft soap, Plant extract	Low?
Slugs	All	Biological control, commodity chemical, plant extract, physical	Med
Whitefly	Protected crop	Biological control	High
Thrips	Protected crop	Biological control	Medium
Flea beetle	Root brassicas	Plant extract	Low
Late blight	Potato, tomato	Plant extract, commodity chemical	Medium
Scab	Top fruit	Plant extract	Low-Med
Canker	Top fruit	Commodity chemical (see Annex 6)	Low-Med
Rust	Leeks	Plant extract	Low
Mildew	Most crops	Plant extract, commodity chemical	Medium

* Available in other EU Member States

5.1.2 Integrated organic policy

There are many priorities for organic sector development in Wales that could justifiably be considered as more important than biopesticide and biological control methods of organic crop protection. However, when considering the barriers to development of organic crop production systems (particularly horticulture i.e. vegetable and fruit production), a significant range of pests and diseases have the capacity to reduce marketable yields, or make it impossible to grow the crop.

Consequently an integrated organic policy for Wales should include measures to ensure that Welsh organic growers have access to the substances and techniques available to organic producers in other EU countries. Furthermore, as the EU Organic Regulation and the review of the Pesticides Directive develop, it will be necessary to consider what new substances or techniques should be put forward to the EU Commission and both must respond to developments in production systems.

5.1.3 Wider pesticide policy

Although there are some important policy initiatives in Great Britain, methods of control suitable for organic producers are not a specific priority for policy makers or their advisory committees. Thus, the Welsh Assembly could support and encourage a greater emphasis on these issues.

It is likely that several of the substances and techniques would have a much wider relevance to non-organic producers, since there are a number of substances and techniques that are not specifically permitted in organic standards (although some might be in the future). To enable this to be achieved, it is necessary to get agreement with other member states – collective preparation of dossiers for common substances is specifically required in the draft 4th Stage procedure.

5.2 Scope for change

Pesticides are regulated in Great Britain at a national level. There is no scope for WAG to unilaterally approve substances or techniques; rather there is an opportunity to contribute to the development of policy at a national and European level. An integrated policy could not only lift some of the obstacles for organic producers, but it could also provide much needed solutions for conventional producers.

There are a number of factors that should be considered, including:

- Physical and multicellular biological controls are not subject to pesticide regulation (but are authorised by the Advisory Committee on Releases into the Environment). Consequently these could be promoted and further developed with the support of a proactive policy regarding pest management in organic systems (for example through the advisory and extension and research services).

- There is enormous scope for the active support for the development of national policy in a way that would help lift obstacles to permitted pesticides for organic production. This would also have implications for conventional producers.

- The process of the review of the Pesticides Directive is lengthy and complex, there is scope for supporting the implementation of the 4th Stage Review in a way that may remove obstacles to the use of organic permitted pesticides.

- It would be useful to Identify partners in other EU member states that may have a common interest – the development of organic policy could be an important bridge.

- Mutual recognition will eventually be applied but this will depend on the completion of the 4th Stage review.

- The current proposals from the Commission for a zonal approach to product authorisations would have a significant impact on the availability of organic permitted pesticides

- Some of the 4th Stage Review substances – are currently seeking authorisation in the UK (one garlic product has been under consideration by the PSD and the ACP since 2000.

- There is scope to support the introduction of new substances onto Annex 2(a). The example of the dossier for Calcium Hydroxide submitted to the EU Commission by the Netherlands is provided in Annex 6.

The plant strengthener approach adopted by Germany seems to be unlikely to be acceptable in the long run, and it would be impossible for WAG to introduce such a policy. Such an approach would have to be adopted at national level and as these are still chemicals, there remains a need to ensure that they are safe to consumers and the environment when applied to food crops.

There are a number of barriers to the development of pesticides and biological controls that may be acceptable under organic standards (some are also relevant to conventional production systems) including, commercial, regulatory and research constraints.

5.2.1 Commercial barriers

Commercially viable products are usually appropriate in global markets where the total crop area is large. This is necessary for industry to recover the high costs of development. Crop and site-specific solutions appropriate to 'minor crops' with a high management requirement for implementation can be hard to make commercially viable. These can be characteristic of organic acceptable methods. In many cases the companies involved are small or very small businesses with little resource. There is also the issue of protecting Intellectual Property Rights for multi-cellular biological control methods. This issue has been considered further by Edwards-Jones *et al,* in the ACP sub-group report on 'Alternatives to conventional pest control techniques in the UK' (Advisory Committee on Pesticides, 2003).

5.2.2 Regulatory barriers

Organic producers can only use substances and methods listed in organic standards and approved by the UK regulatory authority. The limited list defined in the EU Organic Regulation (2092/91) can be supplemented, and there is a procedure in place for this. From the point of view of the pesticide approval process, naturally derived methods of pest and disease control do not fall easily within the existing regulatory framework in the UK. New draft guidance documents from the EU arising from the implementation of the 4^{th} Stage Review of 91/414 are available. In addition, it is expensive to produce the detailed data required for approval. Fees for evaluating and registering a microbial pesticide or pheromone product is £45,000 compared with up to £115,000 for a conventional chemical pesticide (although a lower fee is charged if applicants apply for approval based on mutual recognition route once the active is included on Annex I of 91/414 and the product has been registered to the Uniform Principles in comparable Member States to the UK).

5.2.3 Research barriers

There is a lack of coordinated research and development activity for suitable biopesticides and biological controls and research objectives can be fragmented and short-term. There has been more research and development activity in other European countries than in the UK, both in the academic and in the commercial sector. Finally, some types of pest and disease have received more attention than others, or practical and commercial reasons. Thus for example, biological control of insect pests in protected cropping has been the subject of much successful research, whilst fungal diseases are more challenging and have received less attention.

5.3 Key Recommendations and scope for further work

- WAG should work with the Pesticides Safety Directorate to ensure that the development of pesticide regulatory policy at both National and European level takes full account of the needs of both conventional and organic agriculture and horticulture in the UK.

- There is scope for WAG to support the development of a National Pesticide Policy so that regulatory and commercial barriers impeding the development of organic pesticides are minimised. Not only could greater availability of 'organic pesticides' have a significant impact on organic production in Wales but there could be important implications for conventional horticulture systems and the use of alternatives to conventional pesticides.

- One important regulatory barrier to the registration of 'organic pesticides' is the MRL requirement(s) for their approval and this needs to be resolved. Suitable analytical techniques are required to determine firstly whether these substances result in residues, and secondly to identify the breakdown and residue pathways. So far, this issue has not received the attention of any EU Member State.

- According to the proposed framework for the 4th Stage Review of EU Pesticides Directive 91/414, notifiers are required to produce a dossier, at their own expense, covering characterisation, human toxicity, ecotoxicity efficacy and other relevant data. The Review includes specific provision for companies notifying the same substance to submit a shared dossier. This will help those businesses (many of which are relatively small companies) to save on the high cost of producing the dossiers. It will also aid the Commission since it will reduce the number of dossiers that have to be considered, and ensure that all the available data is included. WAG should encourage and support the production of collective dossiers; although as yet there is no indication of how this will be done in practice, and further details from the Commission are awaited.

- This study has concluded that access to a wider range of 'organically acceptable pesticides' would not have a dramatic impact on organic production in Wales. However, in developing an integrated organic policy, WAG should continue to address the pesticides issue. Some of the methods of pest & disease control in organic systems are either physical or multi-cellular e.g. micro-organisms used as biocontrol agents. WAG agri-environment policy may provide a vehicle to promote these techniques much more actively. Further, it is important to recognise that while Wales alone is too small to have a major impact on commercial and regulatory pressures, WAG can have an impact by working pro-actively with others to make progress.

- There are no published EU or national Member State criteria that can be used to evaluate the acceptability of pesticide substances for organic production. Identifying such criteria and promoting their acceptance at EU level and nationally would allow more active substances to be made available. WAG should work with PSD and others to identify appropriate criteria.

- The specific provisions of Article 7 in Annex 2(b) of the Organic Regulation (2092/91) place potential barriers to the adoption of organically acceptable substances for crop protection. There are a number of potentially useful substances currently not included in the Organic Regulation e.g. potassium bicarbonate. WAG should work with PSD and others to identify such substances and support the production of appropriate dossiers. WAG could also encourage further dialogue between the organic sector and Defra to identify amendments in the Organic Regulations to facilitate the inclusion of new pesticides.

- Organic pest and disease management is not just a question of inputs but it also relies crucially on advice and extension through initiatives such as Farming Connect and the work of Organic Centre Wales. Long-term commitment to supporting on going advice and extension activities is vital to promote and disseminate best practice in Welsh agriculture and horticulture.

- Organic horticulture, vegetable and fruit production systems are particularly sensitive to pest and disease management. Successful control of pests, diseases (and weeds) in these sectors can be critical to the business, and is not assured even when all husbandry and management methods have been effectively applied. Consequently, the use of organically acceptable crop protection methods resulting from future developments (e.g. biopesticides, biological control agents) could have an important role in pest and disease management in these sectors. Both organic and conventional producers in Wales could benefit from having these options available to them and WAG could encourage the adoption of these approaches through appropriate Technology Transfer activities.

- The way in which such substances will be regulated at a European level in future is evolving as the review of the Pesticide Directive 91/414 EEC enters the 4th Stage. This stage of the review includes (amongst others) those substances permitted for use in organic production. The guidance documents for the evaluation of applications on plant protection products made from plants or plant extracts and from chemical substances are currently at the draft stage. The response of the Pesticide Safety Directorate and Defra to these developments is not yet clear but this provides an excellent opportunity for WAG to have an input at an early stage in the review process.

Annex1: Review of methods of crop protection in organic production systems

1.0 Physical barriers

1.1 Crop covers

Physical barriers such as woven fleeces and fine mesh are successfully used to protect some crops from pest attack. At HRI Stockbridge House three barrier systems, Non-woven horticultural fleece, fine mesh (e.g. Gro-net), and fine net 'Environmesh' (e.g. Agrilan) were tested on cauliflower, leek, Chinese cabbage, carrot, swede and lettuce (Davies, 1999). All three barriers effectively controlled flying pests on cauliflower, carrot and swede. Control was moderate for Chinese cabbage and leeks; and poor for lettuce. The disadvantages were cost, questionable environmental acceptability, unsuitability for some crops, and that they do not control soil borne pests.. The main conclusions were that physical barriers produced good results for; moderate results.

Four trials over two years in the Pas de Calais region of northern France, evaluated carrot fly trapping and the timing of fleece application. The conclusion was that fleece could be effective when used against carrot fly but needs to be applied early to reduce damage caused by the first generation of the season. Some level of damage occurred even under the fleece particularly where it had been put on too late to prevent the flies laying eggs on the crop (Legrand, 2001 reported by Sumption, pers. comm.) However, farmers reported that using fleeces for carrots interfered with crop growth and this resulted in lower yields.

1.2 Other Barriers

Barriers of sharp sand or proprietary products such as SnailBan and Tex-R matting may protect plants from some pests, in particular slugs and snails (Caspell, 1999, Schüder *et al.,* 2003). They work either by absorbing moisture from the slug/snail or by providing a coarse barrier across which slugs are reluctant to pass.

2.0 Cultural controls

2.1 Crop Rotation

Crop rotation is an essential component in the management of organic systems for a number of reasons including weed control, fertility management and soil protection. They also have an important role to play in the control of soil borne pests and diseases. Specific rules are laid down in the organic standards to ensure appropriate breaks between certain crops, which contribute to the control of many pests and diseases including potato cyst nematode, white rot on alliums and club root in brassicas. Where possible, growers use longer breaks than those prescribed. Cultivations carried out as part of rotational cropping may also expose soil pests to the elements, and to predators and parasites. For instance ploughing can expose wireworms, chafer grubs and soil insect pests to predation by birds.

2.2 Plant Health

The use of healthy propagating material is of paramount importance and is one of the main strategies for managing certain pests and diseases, such as *Alternaria* in carrots; *Erwinia* soft rot, Black scurf (*Rhizoctonia solani*), and late blight (*Phytophthora infestans*) in potato; leaf spot (*Septoria apicola)* in celery and many others (Gladders *et al.*, 2002). The latest EU Regulation on the use of organic seed does not acknowledge such problems and there is considerable concern among growers that derogations to use conventional seed will not be granted on the grounds of seed quality. These quality issues are particularly acute in relation to the presence of *Septoria* and *Alternaria.*

2.3 Soil Health

The provision of a balanced nutrient supply to growing crops is an important factor in minimising the impact of pests and diseases. This is true of both organic and conventional cropping but it is arguably more important in organic systems because there is very little in the way of inputs. The susceptibility of the growing plant to attack is most notably affected by high nitrogen levels in the soil leading to sappy growth. Low calcium levels increase the likelihood of cell wall damage and subsequent invasion by micro-organisms e.g. lettuce tipburn, internal browning of Brussels sprouts and blackheart of celery (Scaife and Turner, 1983).

The use of well prepared compost both in protected cropping systems and for outdoor crops can increase the number and diversity of beneficial soil micro-organisms that can help to suppress fungal diseases (Carisse *et al.*, 2003, Al-Dahmani, 2003, Cheuk *et al.,* 2003). Green manures can also help to improve the nutrient status of the soil and therefore the health and vigour of the plants. Mustard is claimed in the organic literature as a soil conditioner that controlled both weeds and soil borne pests. Recent work by Frost *et al.* (2002), identified a trend for potatoes grown after mustard to suffer less damage from both wireworms and slugs than potatoes grown after fodder rape or no green manure, but the differences were not significant. Further trials, with longer green manuring periods, were recommended to establish if there is a benefit.

2.4 Trap crops

Brassicae green manures can be used to reduce damage by pests to organic crops using trap crops such as tyfon (turnip x Chinese cabbage) as a trap for flea beetle *Phyllotreta spp*). Similarly, clovers can be grown amongst brassica crops to deter pests (Wolfe, 2002). This work has been taken forward by Collier (2003) who have shown that a range of green understorey crops can disrupt pest activity in brassica crops. There is anecdotal evidence that pigeons prefer fresh clover to brassicas, and one grower in particular designs his rotations to ensure that there is always some near to his brassicas to ensure they stay free from pigeon damage (Sumption, pers.comm.). Evidence has recently been seen that volunteer oats in spring cabbage have deterred pigeons (Hitchings, pers. Comm.).

3.0 Biological Controls

3.1 The Natural System

An 'agro-ecosystem' is a growing environment with a balanced population of beneficial and pest insects (Skinner, 2003). In this agro-ecosystem there are three so called 'trophic' levels: The first is the plant life. The second is the herbivores that feed on the plant material and the third level is the predators and parasites that feed on the herbivores. When these predators and parasites (including insects and pathogens) attack pest species they are sometimes referred to as 'natural enemies' and can reduce pest populations to acceptable levels. This approach to pest management is known as biological control. Control can be 'lethal', where the pest is killed, or sub-lethal, for instance a parasite might reduce or prevent the reproduction of the pest without actually killing it.

Some natural enemies of key horticultural pests are identified in Tables A1 1 (for vegetables) & A1 2 (for top fruit). These can all be found in the natural environment although the levels are often too low to have any affect on crop pests.

Table A1 1: The main vegetable pests and their natural enemies

Pests	**Natural predators**
Aphids	Parasitic wasp *Aphidius colemani* Gall midge-larva *Aphidoletes aphidimyza* Parasitic wasp *Aphidius ervi* Ladybird *Hippodamia convergens* Lacewing *Chrysoperia carnea*
Cabbage white and cabbage moth caterpillars	Parasitic wasp *Trichogramma brassicae* Bacterium *Bacillus thuringiensis* Predatory bug *Podisus maculiventris*
Leatherjacket	Ground beetles Rooks and starlings Predatory nematode *Heterorhabditis megidis*
Thrips	Predatory mite *Amnblyseius cucumeris* Predatory mite *Amblyseius degenerans* Predatory bug *Oris Laevigatus* Predatory bug *Oris majusculus* Fungus *Verticillium lecanii*
Carrot root fly	Gall-midge larva *Feltiella acarisuga* Robber flies *Dioctria atricapilla* Hoverflies *Syrphidae*

Table A1 2: The main top fruit pests and their natural enemies

Pest	Natural predator
Rosy apple aphid (*Dysaphis plantaginea)*	Ladybird *Hippodamia convergens* Lacewing *Chrysoperia carnea* Earwig *Forficula auricularia**
Woolly aphid (*Eriosoma lanigerum)*	Earwig *Forficula auricularia** Parasitic wasp *Aphelinus mali*
Apple blossom weevil (*Anthomonas pomorum)*	Parasitic wasp *Scambus pomorum*
Apple sawfly (*Hoplocampa testudinae*)	Parasitic wasps *Lathrolestes ensator & Aptesis negrocincta*
Mites (*Panonychus ulmi & Tetranicus urticae*)	Predatory mites e.g. *Typhlodromus pyri*
Pear & apple sucker (*Cacopsylla pyricola)*	Anthocorid bugs e.g. *Anthocoris nemorum*
Codling moth (*Cydia pomella)*	Earwig *Forficula auricularia**
Winter moth (*Operophtera brumata*)	Insect feeding birds and carabid beetles

* Earwigs can themselves be a nuisance as they can shelter in fruit clusters and leave droppings

There are fundamentally three approaches to biological control:

- Conserving and encouraging natural enemies already present in the cropping system
- Augmenting populations of natural enemies by introducing 'biological control agents'
- 'Classical Biological Control', where exotic pests are brought under control by the introduction of a natural enemy imported from the pests' country/region of origin.

Only the first two approaches are considered to be relevant to organic crop production in Wales.

3.2 Conserving natural enemies

There are a number of ways in which populations of natural enemies of insect pests can be encouraged and maintained with in a cropping system.

Encouraging certain perennials around a commercial crop helps to attract natural enemies to a source of pollen and nectar as well as cover. Floristically rich hedgerows provide habitats for natural crop pest predators such as *anthrocorid* bugs (a wide-ranging predator found on many flowering plants). Other predators attracted by flowers such as corn marigold, cornflower, corn chamomile and Phacelia include ladybirds (both the beetle and larvae eat aphids) and lacewings (the larvae of green lacewings feed on aphids). Beneficial parasitoid wasps are particularly attracted by umbelliferae (Apiaceae) such as hogweed.

At HRI East Malling, work was undertaken to encourage anthrocorid bugs (Soloman, 1999). In the East Malling orchards the 'herbicide strip' was replaced with an undersowing of a flower mixture comprising corn marigold, cornflower and corn camomile. *Phacelia* (Bee's friend) was found to be less useful, though a total of 15 flowering plants attract anthrocorid bugs. Anthrocorids were attracted to predate on pear sucker (Psyllid) nymphs. Pest populations were reduced by 50% in the trials. For field vegetables the flower mixture could be sown in the hedgerow, headlands or in strips across the field.

Windbreak trees may also be useful in this regard, for instance Alder spp. attract some preadators and parasites. Where natural habitats are lacking, artificial shelters can be introduced such as corrugated cardboard in rolls hung in an upturned plastic bottle with bottom cut out, flower pots and boxes stuffed with straw for lacewings. Log or rock piles can provide over-wintering sites for many predators that will then be active in the field early in the season, helping to slow down, or prevent, the build up of pest populations in the crop.

While this type increasing biodiversity in way described above can have many benefits, growers need to be aware that is some instances, it may also encourage certain pests, and the specific problems and circumstances need to be considered for each individual cropping situation.

3.3 Augmenting natural enemy populations

Where the natural enemy populations already present in the environment are not able to maintain pest levels at acceptably low levels, it is possible to introduce additional natural enemies to achieve control. Organisms (usually insects or pathogens) that are introduced in the system in this way are known as 'biological control agents' or 'biocontrol agents'. There are a number of organic-permitted, commercially available bio-control products for use against aphids, caterpillars, whitefly, vine weevil, sciarid fly, and thrips, and these are listed in Table A1 3.

The main use of live bio-controls is in greenhouses and polythene tunnels to protect crops against a range of insect and other pests. Bacterial preparations are also used in some organic field crops to protect against cabbage white caterpillars (*Peiris brassicae and P. rapae*). This is a developing area with bio-controls being developed for fruit, brassica and carrot pests (Koppert, 2000).

Some biological control agents (mostly pathogens and nematodes) lend themselves to being formulated and applied in a similar manner to synthetic pesticides. They can be suspended in water or oil, and sprayed to treat the affected area. Common examples of this are preparations of a toxin from the soil bacterium *Bacillus thuringiensis*, the fungus *Metarhizium flavoridiae*, which attacks locusts and grasshoppers, the Codling Moth Granulosis Virus and *Phasmarhabditis hermaphrodita, a* nematode attacking slugs and snails. These control agents tend to be highly specific to a particular pest or groups of closely related pests, for instance, *Bacillus thuringiensis* is only effective against caterpillar pests, and *P. hermaphrodita* only attacks slugs and snails.

Table A1 3: Commercially available bio-control agents

Pest	Bio-control agents	Crops
Aphid	Parasitic wasp *Aphidius colemani* Gall-midge (larva) *Aphidoletes aphidimyza* Parasitic wasp *Aphidius ervi*	These products are used on a wide range of protected crops
Caterpillar	Parasitic wasp *Trichogramma brassicae*; Bacterium *Bacillus thuringiensis*;	Trichogramma is generally targeted at caterpillar pests of protected crops while Bt is almost exclusively used on a range of outdoor caterpillar pests
Leaf-miner	Parasitic wasp *Encarsia formosa* Parasitic wasp *Diglyphus isaea*	Protected crops
Sciarid fly	Predatory mite *Hypoaspis spp.* Nematode *Steinernema feltiae*	Protected and containerised crops
Slugs	Nematode *Plasmorhabditis* spp.	Small areas of protected and other high value crops
Spider mite	Predatory mite *Phytoseiulus persimillis* Predatory mite *Amblyseius californicus* Gall-midge (larva) *Feltiella acarisuga*	Generally protected crops such as tomatoes, strawberries, etc. but also hops and outdoor strawberries
Thrips	Predatory mite *Amblyseius ccucumeris* Predatory mite *Amblyseius degenerans* Predatory bug *Orius laevigatus* Predatory bug *Orius majusculus* Fungus *Verticillium lecanii*	Various species of thrips can cause problems in outdoor crops but these biological control agents are exclusively aimed at protected crops notably cucumber
Whitefly	Parasitic wasp *Encarsia formosa* Predatory bug *Macrolophus caliginous* Parasitic wasp Eretmocerus eremicus Fungus *Verticillium lecanii*	Protected crops
Vine weevil	Nematode *Heterorhabditis megidis*	Containerised crops

Source: Koppert (2000)

4.0 Use of resistant varieties

The use of crop varieties that are resistant to pest (resistance to pests is probably less useful than disease resistance) and diseases is one the mainstays of pest management and diseases in organic systems. Attention has been focused on a number of key problems in particular late blight (*Phytophthora infestans*) on potato. From NIAB trials in 1998/99 the following varieties were recommended for organic growers for blight resistance: parti-coloured *Cara*, white skinned *Cosmos* and *Valor*, salad variety *Jutlandia.*

The British Potato Council is supporting blight research including the evaluation of Sarpo varieties from Hungary that are new varieties with very high resistance to late blight and common virus diseases (the potato X, Y and leaf roll viruses). Sixteen potato varieties are being evaluated for resistance to late-blight disease at the Henfaes Research Centre near Bangor. In 2003, *Remarka, Sante, Cosmos, Cara* and *Valor* were showing leaf and stem blight in September and *Stirling* and *Lady Balfour* were much less blighted. In contrast, the Sarpo varieties were healthy and blight free. In a similar trial in Ceredigion carried out by ADAS, a blight prone crop of *King Edward* first became infected in July (pers. comm. David Shaw, Savari Research Trust), while Sarpo varieties were not affected. It is likely that three Sarpo varieties will be on the National List for the 2004 season (Axona, Tominia and one other).

The Scottish Crops research Institute (SCRI) have also done a substantial amount of work on a multitrait breeding programme, combining resistance to late blight (*Phytophthora infestans*) and the white potato cyst nematode (*Globodera pallida*), with high tuber yield and quality. As a result of this work a number of varieties have gone forward to National List trials, and one, "Blush" has since entered the National List as a first/second early table variety.

4.1 Plant vigour

NIAB have identified varietal characteristics suitable for organic cultivation for a number of crops. For broccoli, the variation in soil fertility associated with organic growing means that plants mature over a longer period than when grown with artificial fertilisers and a wider range are required to provide a good cutting spread. Organic growers should look for vigorous and dark coloured varieties (Withers, 1999). A larger transplant gives an earlier start and better weed competition. In NIAB trials, desirable characteristics for organic carrots were identified as vigour of emergence, speed of bulking, good top size and disease resistance (Day, 1999). For organic onion growers the main problem is weed control, multi-seeded blocks/modules and sets are therefore preferred to direct drilling. Sets give higher yields than blocks or modules but have more disease problems (Day, 1999). Onions raised from sets are less well suited to long term storage. For organic parsnips early vigour is vital, as parsnip is not a good weed competitor. Hybrid varieties are therefore useful for organic growers. Canker and leaf blight are the main pest and disease problems (Day, 1999).

5.0 Organically Acceptable Pesticides

Biorational approaches (methods of pest management that are consistent with and often derived from natural biological systems) are preferred, and the use of active ingredients for pest and disease control is restricted to those situations where there is no alternative approaches (Price & Stopes, 2000). The situation for organic growers in Wales is confusing since particular pest & disease control methods used in other European countries, such as herbal based preparations to control potato blight (Marilleau, 2001 reported by Sumption (pers.comm) are not approved for use as a pesticide in the UK under the Control of Pesticide Regulations 1986. According to a 1999 review, almost half of the pest control methods in the UK certification bodies’ Recommended or Permitted lists were not approved for use in the UK by the Pesticide Safety Directorate (Labuschagne, 1999). This situation persists to the present time with the publication of the Compendium of UK Organic Standards in which the proportion of products approved under the EU Regulation and passed for use in the UK is still around 50%.

Insecticidal soft soap can be used to control whitefly, mealy bug, scale insects, aphids, spider mite, thrips and leafhopper *(Hauptidia maroccana).* It can be used on selected brassicas, ornamentals, cucumbers, peppers, fruit trees, lettuce and tomatoes. Products such as rotenone (derris) and natural pyrethrins are restricted because of their wide-spectrum effect that is harmful to beneficial pest predators. Permission from the appropriate certifying body needs to be obtained before such products are used (though not for the soft soap products).

Metaldehyde is still allowed for slug and snail control until 31st March 2006 providing it is only used in traps containing a repellent to higher animal species. A recent addition to the list is iron (III) orthophosphate – it is listed as a molluscicide though information on its efficacy has been hard to find. Neither of these products is in the 'need recognised by inspection body' category though iron (III) or ferric phosphate only has PSD approval for Amateur use. Because of this it has not been possible to locate much information on this product.

Various copper products (hydroxide, oxychloride and sulphate) are still approved under the organic standards and PSD for control of various fungal diseases such as late blight in potatoes, scab in top fruit, and mildew in vines and top fruit. The EU intends that it is ultimately withdrawn from the organic standards and there is a protocol in place for its gradual removal over the next 5-7 years. Elemental sulphur is used for the control of fungal diseases though its efficacy is generally lower than that of the copper products. It can however be used without advance permission from the inspection body.

Annex 2: Key pest and disease problems in Wales and their management

Organic growers in Wales counteract the key pest and disease problems using several methods of management and control (Frost 2003, Gladders *et al*., 2002, Fraser and Tyson, 1993). The management practices currently employed, and the existing or potential role that organic acceptable pesticides could play in their management in the future is outlined in the tables below (Table A2.1 pests, and Table A2.2 diseases of horticultural crops).

In the table below the assessment of potential benefit is based on the seriousness of the pest or disease and the degree to which the problem is controlled at the present time. Where the term 'low' is used it means that the problem is already controlled to a relatively high degree. It may also mean that the problem is not that important for Welsh growers.

Table A2 1: Key management practices for insect pests of horticultural crops

Pest	Key management practices	Potential benefit from organically acceptable pesticides
Aphids	Physical barriers (fleece, mesh, etc.), Biological control (Lacewings, Ladybird (Coccinellidae) larvae, Parasitic wasps e.g. *Aphis colemani).* Encouragement of natural enemies, modified sowing dates, pesticide e.g. insecticidal soft soap, UV blocking plastics, polythene covered cropping, targeted irrigation.	Medium
Carrot fly	Resistant varieties, Modified harvesting dates, Encouraging natural enemies, crop covers	Low
Caterpillars	Physical barriers (fleece, mesh, etc.). Encouragement of natural enemies, modification of planting dates, Biopesticides e.g. *Bacillus thuringiensis*	Medium
Leather Jackets	Encourage predators such as ground beetles. Shallow cultivations to expose the pest to predators. Keeping grass tightly grazed in later summer to help prevent the adult crane flies laying eggs	Low
Slugs	Bio-pesticides i.e. predatory nematodes (*Phasmorhabditis hermaphrodita*) for high value crops. Removal of slug habitats by seedbed consolidation, tight cutting of headlands, reduction of weeds and avoidance of damp, poorly drained areas, thorough cultivation (destroys slugs and exposes eggs and juveniles increases desiccation and predation). Resistant cultivars, trap plants, encouragement of natural enemies, Physical barriers, (feeding deterrents, repellents, e.g. garlic, Snailban, Tex – R matting)	High
Thrips	Physical barriers Biological control in protected cropping	Low
Whitefly (Mostly a pest in protected cropping)	Physical barriers Biological control, resistant varieties	Low
Wire worms	Rotations (especially those including mustard), avoid following long term grass leys with susceptible crops, ploughing, exposure to predators e.g. birds	Low

From Frost, (2003), Gladders *et al*., (2002),

Table A2.2: Key management practices for diseases of horticultural crops.

Crop	Disease	Key management practices	Potential benefit from organically acceptable pesticides
Brassicas	Club root	Prevent introduction through machinery, compost transplants etc. Soil amendments e.g. liming, removal and destruction of infected plants and crop debris, long rotations, (partially) resistant varieties, avoid infested land, Test field soils for club root	Low
	Downy mildew	Resistant varieties,	Medium
	Dark leaf spot	Clean seed, clean break between over-winter and spring crops. Crop hygiene	Low
	Ring spot	Resistant varieties, avoid growing brassica crops all year round, crop hygiene	Low
Broad Beans	Rust	Crop hygiene, control volunteers, maintain good potash status	Low
Carrot	Alternaria blight	Clean seed, crop hygiene, resistant varieties	Low
	Cavity spot	Avoid 'problem fields', resistant varieties, early lifting if problem is detected, rotation	Low
Celery	Leaf spot	Clean seed (Hot water treatment) (treatment with Thiram is been allowed until new seed regulations adopted) clean transplants, separate successional crops in space terms i.e. not adjacent, rotation, removal/destruction of previous crop debris.	High
Crop	**Disease**	**Key management practices**	**Potential benefit from organically acceptable pesticides**
Cucurbits (Courgettes pumpkins)	Powdery mildew	Resistant varieties, crop hygiene, sulphur, maintain good soil moisture levels using irrigation	Medium
Leeks	Rust	Rotation, resistant cultivars and debris removal.	Medium
Lettuce	Downy mildew	**Resistant varieties**, clean transplants, crop hygiene. Environmental manipulation e.g. to reduce relative humidity (protected cropping), removal and destruction of infected plants and crop debris	High
	Grey mould	Avoid damage to transplants, avoid wet areas and ensure balanced nutrients and adequate water. Environmental manipulation e.g. to reduce relative humidity (protected cropping). No resistant varieties available, removal and destruction of infected plants and crop debris.	Medium

Onions	Downy Mildew	Break cycle of onion cropping. Resistant varieties/ species. Area co-coordinated plantings.	Low
	Neck rot	Clean seeds/sets – (Hot Water Treatment), minimise mechanical damage (in field and in storage), effective drying of crop	Low
	White rot	Avoid infected fields & prevent contamination through soil on machinery etc. clean propagating material, hygiene, **very long rotations** (>10 years) Biocontrol (e.g. with *Conyothyrium minitans*, commercially available in Germany). Use of compost based on onion waste – see HDC Project	Low (would be high if acceptable input identified)
Potato	Late blight	Removal and destruction of infected plants and crop debris, clean seed, resistant varieties, acceptable fungicides e.g. copper	High, due to potential withdrawal of copper
	Blackleg/ Bacterial soft rot Black scurf	Use clean seed, careful handling of seed, resistant varieties Shallow planting, clean seed, prompt harvesting, long rotations.	Low Low
	Common scab	Water management (avoid dry conditions), resistant varieties, use of clean seed, green manures, soil pH – not too alkaline – possible problems if in a rotation with brassica crops	Low
	Spraing (soil-borne virus disease)	Rotation and effective control of volunteer potatoes and weeds	Low
Tomato	Potato blight	Crop hygiene i.e. **immediate** removal and destruction of infected plants/plant parts, resistant varieties, avoid growing adjacent to potato crops. Environmental manipulation e.g. to reduce relative humidity (protected cropping), removal and destruction of infected plants and end of season crop debris.	High, due to potential withdrawal of copper
	Pepino Mosaic Virus	Clean seed (phytosanitary measures) strict bio-security	Medium

From Frost (2003), Gladders *et al.,* (2002),

Annex 3: Extract from EU Regulation 2092/91 Annex II(b), 06.08.2003:

List of substances permitted for plant protection in organic production, with description and conditions of use.

Name	Description, conditions of use
I. Substances of crop or animal origin	
Azadirachtin (extract from *Azadirachta indica* - Neem tree)	Insecticide. Need recognised by control body
Beeswax*	Pruning agent
Gelatine	Insecticide
Hydrolised proteins*	Attractant, only in combination with other products of Annex II(B)
Lecithin	Fungicide
Nicotine (aqueous extract from *Nicotiana tabacum*)	Insecticide. Aphids in subtropical fruit trees, tropical crops, only at start of vegetative period. Need recognised by control body.
Plant oils (e.g. mint, pine, caraway)	Insecticide, acaricide, fungicide, sprout inhibitor
Pyrethrins (extract from *Chryanthemum cinerariaefolium*) #	Insecticide Need recognised by control body
Quassia (extracted from *Quassia amara*)	Insecticide, repellent
Rotenone (extracted from *Derris spp.* & *Lonchocarpus spp.* & *Terphrosia spp.*) #	Insecticide. Need recognised by control body.
II. Microorganisms used for biological control	
Microorganisms (bacteria, viruses & fungi) e.g. *Bacillus thuringensis #, Granulosis* virus, etc	Only products not genetically modified in the meaning of EU Directive 90/220/EEC
III. Substances in traps and/or dispensers	
Diammonium phosphate*	Attractant, only in traps
Metaldehyde #	Molluscicide, only in traps with repellent to higher animals. Only until March 2006
Pheromones	Attractant; sexual behaviour disrupter; only in traps & dispensers
Pyrethroids (only deltamethrin or lambdacyhalothrin)	Insecticide, only in traps with attractants. Only against *Batrocera oleae* & *Ceratitis capitata wied*. Need recognized by control body.

List of substances permitted for plant protection in organic production, with description and conditions of use. Contd.

IIIa. Preparations to be surface-spread between cultivated plants	
Iron (III) orthophosphate #	Molluscicide
IV. Other substances from traditional use in Organic farming	
Copper (copper hydroxide #, copper oxychloride **#,** (tribasic) copper sulphate **#,** cuprous oxide	Fungicide. Need recognized by control body. Maximum application of 8kg copper per hectare until 31 Dec 2005; 6kg copper per hectare thereafter
Ethylene* #	Degreening bananas
Fatty acid potassium salt (soft soap) #	Insecticide
Potassium alum (Kalinite)*	Prevention of ripening of bananas
Lime sulphur (Calcium polysulphide)	Fungicide, insecticide, acaricide; Need recognised by control body
Paraffin oil #	Insecticide, acaricide
Mineral oils	Insecticide, fungicide. Only in fruit & olive trees, vines and tropical crops (e.g. bananas). Need recognized by control body.
Potassium permanganate	Fungicide, bactericide. Only in fruit & olive trees and vines
Quartz sand*	Repellent
Sulphur #	Fungicide, acaricide, repellent

* In certain member states these products are not considered as plant protection products and are not subject to the provisions of the plant protection legislation.
Source: EU, 1991, as amended.

These active ingredients are noted in the current Compendium of UK Organic Standards as carrying current UK approval for use in agriculture, horticulture or the home garden.

Annex 4: Letter and Questionnaire sent to EU member states

Tony Little
Advisory Services Co-ordinator
Organic Centre Wales
University of Wales, Aberystwyth
SY23 3AL

2nd December 2003

Dear

Approval & regulation of pesticides suitable for organic production systems
The Welsh Assembly Government (WAG) in the UK has developed an Organic Action Plan for Wales with a stated aim that 10% of Welsh agricultural production should be organic by 2005.

WAG is committed to pesticide regulation that ensures acceptable safety of pesticides in terms of human health and the environment, whether used in organic or conventional production systems. In view of possible data gaps for some substances that may be used in organic systems, it is important to establish whether a full data package is necessary or desirable, or whether an alternative approach to the regulation of pesticides permitted for use in organic production systems would be appropriate.

We have been asked by WAG in the UK to carry out an appraisal of the regulatory approach adopted by EU Member States for the registration and approval of pesticides authorised for use in organic systems as listed in Organic Regulation EEC 2092/91, Annex II(b) (please see the attached list of substances as in the Regulation).

In addition to those materials listed in Annex II(b) we are also interested in other substances that are currently not on Annex II(b) of the Organic Regulation for example: pheromones, allelochemicals, entomopathogenic fungi, mycoherbicides, antagonistic fungi, antifeedants/deterrents and plant extracts. Currently, these are regulated by Directive 91/414 and/or by Member State legislation depending on the claim made on the product label.

The UK Pesticides Safety Directorate has provided your contact details. We would be most grateful if you could find the time to answer the simple questions and complete the form attached. An early response would be very much appreciated. We will be contacting by 'phone in the next few days to confirm receipt and answer any questions you may have.

Yours sincerely

T Little	N J Bradshaw	C Stopes,	D Buffin
Organic Centre Wales	ADAS Consulting Ltd	EcoStopes Consultancy	Pesticide Action Network, UK

Questionnaire

A study of EU Member States' approaches to the registration, sale and use of pesticides suitable for organic production systems.

Member State: ……………………………………………………………………………..

Contact Name: ……………………………………………………………………………..

Email address: ……………………………………………………………………………..

Address of regulatory body: ………………………………………………………………

Are any of the active substances currently listed in Annex II, Section B of Council Regulation 2092/91 EEC commercially available in your country for use as Plant Protection Products?
Please use the attached form to complete your response.

For each active substance approved, please provide the following details on the attached form:
Proprietary product(s)
Field(s) of use (crop(s), restrictions)
Label claim (s)

Have these active substances been evaluated under your country's pesticide regulations?

If so please provide details of how the risk assessment was carried out by answering the following questions:
What information was required to ensure safety to humans?

…………………………………………………………………………………………………

What information was required to ensure safety to the environment?

…………………………………………………………………………………………………

Was a 'reasoned argument' accepted for any or all of the substances approved? How is this principle applied?

…………………………………………………………………………………………………

What are the efficacy requirements for 'organically acceptable pesticides' i.e. how effective should they be, what level of control is acceptable, is comparison with existing conventional pesticide standard required ?

…………………………………………………………………………………………………

Are any of the active substances listed in Annex II(B) Regulation 2092/91 commercially available in your country but NOT sold as Plant Protection Products?
Please use the attached form to complete your response.

For each active substance, please indicate on the attached table if the substance is NOT sold as a Plant Protection Product.

Do these uses fall outside the scope of your country's Pesticide Regulations?

…………………………………………………………………………………………………

Are these uses regulated in other ways?

……………………………………………………………………………………………

If any of the following groups of active substances commercially available in your country, please give their regulatory status under your country's pesticide regulations? Please state what safety and efficacy data would be required.

Substance	**Status under regulation**	**Required safety data**	**Required efficacy data**
Pheromones			
Allelochemicals			
Biological control agents (insect predators parasites) Entomopathogenic fungi Mycoherbicides			
Antagonistic fungi			
Antifeedants/eating deterrents			
Plant extracts			
Commodity chemicals			

Would a reasoned argument be accepted for each active substance or would a risk assessment be carried out for each field of use or label claim?

……………………………………………………………………………………………

Are pesticides regulated by regionally in your country?
Please answer Yes or No

……………………………………

Member State pesticide regulations are currently being superseded by Council Directive 91/414 EEC. Do you consider this appropriate for 'organic or non conventional' pesticide active substances?

……………………………………………………………………………………………

Your co-operation in completing this questionnaire is gratefully appreciated

T Little
Organic Centre Wales

N J Bradshaw
ADAS Consulting Ltd.

C Stopes
Eco-Stopes Consultancy

D Buffin
PAN UK

EU Member States' registration, sale and use of pesticides suitable for organic production.

PLEASE COMPLETE THE FORM: Country: ………………………………………………………………

	Question 1				Question 3	
Name of plant protection product	**Permitted for use as Plant Protection Product**	**Proprietary name(s)**	**Permitted crop(s)**	**Label Claim**	**Not sold as Plant Protection Product**	**Permitted use if not PPP**
I. Substances of crop or animal origin	**YES or NO**					
Azadirachtin (extract from *Azadirachta indica* - Neem tree)						
Beeswax*						
Gelatine						
Hydrolised proteins*						
Lecithin						
Nicotine (aqueous extract from *Nicotiana tabacum*)						
Plant oils (e.g. mint, pine, caraway)						
Pyrethrins (extract from *Chryanthemum cinerariaefolium*)						
Quassia (extracted from *Quassia amara*)						
Rotenone (extracted from *Derris spp.* & *Lonchocarpus spp.* & *Terphrosia spp.*)						
II. Microorganisms used for biological control						
Microorganisms (bacteria, viruses & fungi) e.g. *Bacillus thuringensis, Granulosis* virus, etc						
III. Substances in traps and/or dispensers						
Diammonium phosphate*						
Metaldehyde						
Pheromones						

	Question 1				Question 3	
Name of plant protection product	**Permitted for use as Plant Protection Product**	**Proprietary name(s)**	**Permitted crop(s)**	**Label Claim**	**Not sold as Plant Protection Product**	**Permitted use if not PPP**
Pyrethroids (only deltamethrin or lambdacyhalothrin)						
IV. Other substances from traditional use in Organic farming						
Copper (copper hydroxide, copper oxychloride, (tribasic) copper sulphate, cuprous oxide						
Fatty acid potassium salt (soft soap)						
Lime sulphur (Calcium polysulphide)						
Paraffin oil						
Mineral oils						
Potassium permanganate						
Quartz sand*						
Sulphur						

Annex 5: Notifications by member states under 4th stage Review of EU Pesticides Directive (91/414) of substances permitted for use in the EU Organic Regulation (2092/91). Adapted from SANCO (2003).

Substance as notified	No substances	No countries	No Repellants	AT	BE	DE	ES	NL	FR	IE	IT	DK	GB	GR	SE	FI
Part A:																
Authorized for use in human foodstuffs or animal feeding stuffs																
Fatty acids/potassium salt	20	7				5	2	1			3	2	6	1		
Plant extracts																
Azadirachtin	13	6			1	2	4		1		4				1	
Citronellol	1	1	1						1							
Citrus extract & grapefruit seed extract	2	2					1					1				
Garlic	9	4	5				3		1		4		1			
Lecithin	3	2				2	2									
Marigold extract	1	1					1									
Mimosa tenuiflora extract	1	1					1									
Nicotine	3	2	1				1						2			
Pepper	2	1	2										2			
Blackcurrant bud oil	1	1	1												1	
Citronella Oil	2	1	1										2			
Clove oil	2	2	1						1						2	
Etheric oil	2	1	2					2								
Eucalyptus	2	2							1		1					
Gaiac Wood oil	1	1					1									
Garlic oil	2	2	1					1					1			
Lemongrass oil	1	1	1												1	
Marjoram oil	1	1	1					1								
Olive oil	1	1						1								

Substance as notified	No substances	No countries	No Repellants	AT	BE	DE	ES	NL	FR	IE	IT	DK	GB	GR	SE	FI
Orange oil	1	1	1										1			
Pinus oil	5	4	1			1		2	1		1					
Rape seed oil	8	5				3		1	1		1		2			
Soya oil	3	2	1				1	2								
Spearmint oil	1	1							1							
Sunflower oil	3	3						1	1				1			
Thyme oil	1	1	1					1								
Ylang-Ylang oil	1	1	1												1	1
Pyethrins	11	6		1		1	2		3		1		3			
Quassia	5	4				2	1		1		1					
Rotenone	5	3				1			2		2					
Sea-algae extract	4	4				1			1	1	1					
Seaweed	7	5					1	1	2	1	2					
Commodity substances																
Kieselgur (Diatomaceous earth)	5	3				3		1						1		
Lime sulphur	3	2				1					2					
Paraffin oil																
Part B Exclusively attractants or repellants																
Pheromones	72	9	All	8	1	8	7	23	12		6			5	2	
Daphne oil	1	1				1										
Quartz sand	4	3		1		2		1								
Part C Micro-organisms																
Bacillus sphaericus	1	1							1							
Bacillus thuringiensis spp	16	5			2	1	3		4		6					
Beauvaria bassiana	4	4					1		1		1			1		
Beauvaria brongniartii	1	1							1							
Cydia pomonella granulosis virus	5	4			1	1			1		2					
Metarhizium anisopliae	3	2				1					2					
Neopridrion sertifer nuclear polyhedrosis	1	1														

Substance as notified	No substances	No countries	No Repellants	AT	BE	DE	ES	NL	FR	IE	IT	DK	GB	GR	SE	FI
virus																
Phlebiopsis gigantea	2	2												1		
Streptomyces griseoviridis	1	1														
Trichoderma spp.	11	6			1		1	1			5		1			2
Verticillium dahliae	2	1						2								
Part D Rodenticides																
None																
Part E Disinfectants																
None																
TOTAL	257			10	6	36	33	42	38	2	45	3	22	9	8	3
TOTAL excluding Pheromones	185			2	5	28	26	19	26	2	39	3	22	4	6	3

Annex 6: REQUEST TO AMEND ANNEX II B - Pesticides

Delete 2 of 3:

Inclusion

Introduced by [2]: The Netherlands
Date : 09.09.2003
Contact e-mail : w.l.reerink@minlnv.nl

Name	Description, compositional requirements, conditions for use
CALCIUM HYDROXIDE	• Fungicide. • Only for control of canker (*Nectria galligena*) in fruit growing (apple, pear) incl. fruit tree nursery

1. Identification

Chemical name(s) of active substance: calcium hydroxide
Other names: calcium dihydroxide, calcium hydrate (slaked lime, hydrated lime)
Trade names: - Superkalk 95 (of Carmeuse bv, Gouda, The Netherlands) - there are many other producers and trade names
CAS[3] name: not available. CAS number 1305-62-0
IUPAC[4] name: not available Other code(s): EINECS Code 2151373

2. Characterisation

Composition: calcium hydroxide $Ca(OH)_2$ (97,70%), CO_2 1,10%, MgO 0,60%, SiO_2 0,70%, Al_2O_3 0,15%, Fe_2O_3 0,15%, Mn_3O_4 0,02%, S 0,03%, H_2O 0,70%.
Concentration of active substance: 960 g/kg
Physical properties: • Fine grade powder. Particle size: 98% < 0,075mm. • Density: 2,342 g/ml • Specific surface: 17 m^2/g • Colour: white • Acid binding capacity (the ability of fertilizers and manures to raise (or lower) soil pH): 60 units per 100 kg of product (compared with CaO 80 units, $CaCO_3$ 40-50 units, stable manure (cow) 0 units, chicken manure 10-20 units)
Origin, production method: Limestone (calcium carbonate) is mined, then heated to at least 900ºC (burned) to get calcium oxide ($CaCO_3$ => CaO+CO_2?), then mixed with water (slaked) to get calcium hydroxide (CaO+H_2O => $Ca(OH)_2$). This is one of the procedures to obtain liming materials to be used as a fertiliser. Beside limestone also shells can be used as raw material.
Formulation (emulsifiable, concentrate, wettable powder):

[2] Name of Member State
[3] Chemical Abstracts Systematic Names
[4] International Union of Pure and Applied Chemistry

• The powder is mixed with water without the use of additives (emulsifiers, wetting agents etc.). Mixing is done by the fruit grower (see point 3). • There is a risk of clogging of the suspension. Because at the moment there is no interest with the producers in formulating the raw material, it is advised - to use products of a fine grade; - to use sprinkler installations with short tubes; - to avoid long standing of the suspension.
Effect on harmful organism and action mechanism: reduction of sporulation and germination of spores of canker (*Nectria galligena*) by the high pH.
Selectivity: Yes • Despite the slowing of decomposition of fallen leaves – when calcium hydroxide is applied in the autumn during leaf drop (see point 3) – there is no demonstration of adverse effects on pressure from scab (*Venturia inaequalis* resp. *V. pirina*) in the following spring. Explanation: Fallen leaves which only partly decompose (or do not decompose at all) during winter, offer an opportunity to the scab-fungus to produce fruit bodies (pseudothecia). In spring these pseudothecia scatter their ascospores which infect the new-developed leaves. So, the less the decomposition of leaves in winter, the greater the risk of scab infections in spring. ❖ De Jong et al (2001) of the Dutch Fruit Research Station investigated the decomposition of the leaves. The slowing effect of calcium hydroxide was comparable to that of Captosan, a captan-containing fungicide used for canker control in conventional fruit growing. ❖ In several years of experiments on canker control by the Fruit Research Station and the Louis Bolk Institute (also situated in the Netherlands), extensive observations on canker at the end of the primary scab season never showed adverse effects on scab development in the treated plots. • Observations for several years on rosy apple aphid in treated orchards do not give an indication of adverse effects on natural enemies. (Bloksma et al, 2003)

3. Uses

Use category (insecticide, fungicide, etc.): fungicide
Application method: by sprayers or overhead sprinklers
Dosage: • Production orchard: 50 kg in 1000-1500 litres of water / ha / application (sprayers) 100 kg in approximately 5000 litres of water / ha / application (sprinklers). 5000 L/ha is comparable with ½ mm of rainfall. • Fruit tree nurseries: proportionally lower dosages.
Stage of plant development: • Production orchard and fruit tree nursery: the period with open leave scars (the not-overgrown scars of fallen leaves, so not protected from canker infection). Leaf drop is during the autumn months (The Netherlands: about November). • Fruit tree nursery: open pruning wounds (wounds of lateral branches of the rootstock which have been cut back). This is during the summer months. In both cases the trees do not bear fruits.
Application frequency: • During leaf drop: about 6 times, under bad weather conditions several times

more.
- During pruning : about 3 times.

4. Status

Historic use:

- Calcium-containing products as soil conditioner and nutrient. Since long, calcium hydroxide and other limestone products are used as liming material in agriculture. According to Annex IIA of Regulation (EEC) 2092/91 several products containing calcium are allowed to be used as a soil conditioner in organic farming. For example, calcium carbonate ($CaCO_3$), that is also formed after application of calcium hydroxide.
  In Annex I, examples are given of the effect of the application of calcium hydroxide against canker on the calcium balance in the soil in organic orchards in the Netherlands on different soil types.
- Calcium containing products as plant protection agent. In traditional fruit growing calcium-containing products were sprayed on the trees as some kind of hygienic measure, killing hibernating organisms (insects, mites, fungi).
  It is well known that fungi are inhibited in environments of (very) high pH. The pH of a 5% suspension of calcium hydroxide is 11.5.
-

Regulatory status:

- European Union: notified by the Dutch Plant Protection Service (by order of the Ministry of Agriculture) according to article 4 and article 5(2)(a) of Commission Regulation (EC) No. 1112/2002. This EC Regulation refers to the fourth stage of the programme of work of Council Directive 91/414/EEC concerning the placing of plant protection products on the market.
- The Netherlands: authorised under the RUB. The RUB (Regeling Uitzondering Bestrijdingsmiddelen = Regulation Exemption Pesticides) authorises pesticides with such low risks for man and environment that the usual procedures for authorisation are considered unnecessary.

5. Criteria article 7

Necessity[5]:
In Europe, countries/regions with a prevailing sea climate (The Netherlands, Denmark, Great-Britain, the West of Belgium and France, the Northwest of Germany) have to deal with serious problems with canker (*Nectria galligena*) in fruit trees. Under the influence of the North-Atlantic Gulfstream this climate has rather cool summers, rather warm winters, little frost, and a rather evenly distribution of rainfall over the year. To a lesser extent, fruit tree canker may also cause damage in other regions in Europe, e.g. the Bodensee-region and the North of Italy.
Cultivation techniques such as moderate growth level are already common practise in organic fruit growing, but are insufficiently effective to prevent damage by canker.
Copper compounds are effective, but in several EU Member States, among which The Netherlands, copper is not allowed as a plant protection agent.

[5] See article 7.1 (a) : essential for the control of a harmful organism or a particular disease for which other biological, cultural, physical or breeding alternatives are not available

Except for copper, there are at the moment no alternatives for calcium hydroxide to control fruit tree canker in organic farming (see point 6). Without an effective agent against canker, organic fruit growing suffers large economic losses: • Production orchards. Canker control without plant protection products requires frequent work on cutting away infected parts. Nevertheless, branches or entire trees can be lost. ▪ The cutting away of infected parts may take two rounds of 40 man-hours/ha each in summer and one round of up to 100 man-hours/ha in autumn. ▪ During the first two years of an orchard's life cycle infested trees are replaced. After this, every loss of (parts of) trees means a reduction in production potential. Losses of 10% of the total tree volume are not unusual in older plantations. Moreover, in heavily infested orchards *Nectria galligena* also causes losses of harvested fruit due to storage rot. *Nectria* can infect the fruit and these infections manifest themselves especially during storage. • Production of fruit trees in organic fruit tree nurseries is almost impossible due to problems with canker. Sorting out healthy planting material drastically raises the costs of the trees. On top of that many infections only come to expression when the trees are already planted in the orchards. Losses of up to 15% in the first year were documented for the new scab-resistant apple variety Topaz in 2002 (Louis Bolk Institute, as yet unpublished). So, most Dutch organic fruit growers will buy conventionally cultivated planting material if they can get permission of the inspection body.
Contact with crop: No (application after harvest, or in the fruit tree nursery).
Environment (effects, contaminants): • Calcium hydroxide is harmless to aquatic life and soil life, according to the environmental criteria (the "environmental yardstick") of the Dutch organisation CLM Research and Advice. In Annex II, a comparison according to this yardstick is made between copper and calcium hydroxide. • Due to its effect on the pH of the soil, the use of calcium hydroxide has to be considered as a factor regarding the liming management of the orchard soils (see Annex I).

6. Other aspects

Human health and quality: 1) Classification and labelling of the active substance: • Hazard symbols Xi • Risk phrases R41 • Safety phrases S2, S8, S24, S25, S26, S38, S36/37/39 So, wearing of mouth, nose and skin protection is necessary during dissolving the powder. 2) Effective control of canker saves labour and money. An explanation is given in point 5 (Criteria article 7).
Various aspects (ethical, animal welfare, socio-economic): –
Alternatives: • Copper, if authorised by Member State according to Annex II.

- Canker resistant apple varieties. Lateur (2001), who developed a screening procedure to determine resistance in apple varieties, concluded that there are only a few resistance sources available to breeding. None of them shows absolute resistance. At the moment, there are no commercially important apple varieties with a good resistance.
- Research on antagonistic micro organisms started already in the beginning of the seventies (Swinburne, 1973), but there are no indications that this research will result in a commercially available product in the near future.

Conclusion: Except for copper, there will be no alternatives available on the short term.

7. Conclusion

Beside scab, canker is a main disease problem in (organic) fruit growing in countries with a sea climate. To a lesser extent, canker is also a problem in several other regions of the EU. Calcium hydroxide can control canker as effectively as synthetic chemicals. At the moment, there is no alternative for calcium hydroxide in countries where copper compounds are not allowed. Research on breeding of resistant varieties and on control by antagonistic micro-organisms will not result in practical solutions for growers in the near future.

8. Annexes

- I Calcium balance in orchards on different soil types, treated with calcium hydroxide against fruit tree canker.
- II Environmental effects of calcium hydroxide according to the environmental yard stick of CLM.

9. Other references

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ANNEX I: Calcium balance in orchards on different soil types, treated with calcium hydroxide against fruit tree canker.

1. Liming effect of Calcium hydroxide.

When calcium hydroxide ($Ca(OH)_2$) is applicated, only part of it precipitates on the tree. Here it reacts with carbon dioxide from the air to form calcium carbonate ($CaCO_3$). The other part directly precipitates on the soil. Here too, it reacts with carbon dioxide to form calcium carbonate (which is the substance naturally occurring in soils). So, in both instances the liming effect upon the soil of the applicated calcium hydroxide is the same: 60 units of acid binding capacity per 100 kg of product (see Request, point 2).
The larger acid binding capacity of calcium hydroxide (60 units / 100 kg product) compared to calcium carbonate (40-50 units / 100 kg product) in Request point 2 is caused by the smaller particle size.

During leaf drop calcium hydroxide is applicated about 6 times at a maximum rate of 100 kg/ha/application (sprinklers).
600 kg calcium hydroxide has an acid binding capacity of 360 units.

2. Calcium balance of fruit growing soils based on supply and loss of acid binding capacity.

a) Supply	units per ha
Calcium hydroxide	(+) 360
b) Loss	
- Natural loss of calcium from soils, including withdrawal by the crop	
• Grassland	(-) 100
• Arable land	
Sand, low organic matter content	(-) 150
Sand, high organic matter content	(-) 200 to 250
Sandy clay and clay	(-) 400
- Rainfall (“acid rain”)	(-) 50 to 60
- Scab and mildew control by sulphur	
Depending on disease control programme	
10-100 kg S /ha	(-) 5 to 50

In general, orchard soils can be seen as a combination of arable land and grassland, about 50%-50%.

3. Soil types in Dutch fruit growing.

In the Netherlands fruit is grown on 3 types of soil.

1) Sand and sandy clay, with sufficient organic matter but poor in calcium. Beside the maintenance liming in order to stabilize the pH of the soil, these soils sometimes need a repair liming to raise the pH.
2) Sandy clay and clay, with sufficient organic matter and moderate in calcium. At best a maintenance liming is needed.
3) Clay, poor in organic matter and rich in calcium. Soil pH over 7,0, which is too high for optimum fruit growing. So, use of acidifying materials (like green organic matter) in order to lower the pH is needed. In practice this lowering is very difficult, because the large amount of calcium carbonate in the soil forms an effective buffer.

Elsewhere in Europe, comparable soils occur in organic growing.

4. Calcium balance in orchard soils in The Netherlands.

Natural loss from orchard soils in the Netherlands can be estimated at (100+225):2 = 160 units (sand, high organic matter content) and (100+400):2 = 250 units (sandy clay, clay) on an average and the total loss at about (160+(50 to 60)+(5 to 50) = 215 to 270 units (sand) and (250+(50 to 60)+(5 to 50) = 305 to 360 units (sandy clay, clay).

The effect of application of calcium hydroxide (360 units) on the calcium balance in the Dutch orchard soils is as follows:

- On sandy soils there is a small surplus of about 100 units.
- On sandy clay and clay supply and loss are more or less in equilibrium.
- In both situations, the use of calcium hydroxide has to be considered as a factor in the liming management. If pH has to be raised, calcium hydroxide can be combined with other liming materials. If pH has to be lowered, acidifying materials can be employed.[*]

Literature:

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[*] To see it in its right perspective: if the grower wants to raise pH of a sandy soil with 0.1, he needs per 10 cm soil depth about 100-150 units of acid binding capacity. In soils with silt he needs about 200-300 units for this raising. Repair liming can require as much as 500-1000 units.

ANNEX II
Environmental effects of calcium hydroxide, according to the environmental yardstick of CLM

CLM Onderzoek en Advies BV (CLM Research and Advice) is a private organisation aiming at the development of environmentally sound, sustainable systems of agriculture by research, advice and process support.
In the nineties CLM developed, in cooperation with research institutes, the so-called environmental yardstick.
Data of plant protection products on toxicity for aquatic life and soil life and on persistency and mobility in the soil were (and are) translated in scores (milieubelastingspunten = MBP) per kg of product. Together with data on emission to and deposition on surface water by spraying in the open air (the drift-percentage) the user of the environmental yardstick can calculate the total scores of an application for aquatic life and soil life and determine if these scores lie within or outside environmentally acceptable limits. These limits are based on the criteria for authorisation of plant protection products by the Dutch government. Of course, it is also possible to calculate the total scores of a pest and disease control programme and to compare this with other programmes.

For calcium hydroxide, CLM determined the following scores per kg product per application[*]
- aquatic life 0 point
- soil life 1 point

Acceptable limits per application of a plant protection product
- aquatic life 10 points
- soil life 100 points

Conclusion: application of calcium hydroxide for canker control at a rate of
< 50 to 100 kg / ha per application is harmless to aquatic and soil life:
- Scores for aquatic life (drift-percentage 7): (<50 to 100) x 0 x 7 = 0 points;
- Scores for soil life: (<50 to 100) x 1 = < 50 to 100 points.

Comparison of calcium hydroxide with the alternative copper oxychloride.
- Minimum effective rate of copper oxychloride in canker control: about 3 kg product/ha per application[♣];
- CLM determined the following scores per kg product per application:
  - aquatic life 7 points
  - soil life 3 points;
- Scores in canker control

		3 kg Copper oxychloride	100 kg Calcium hydroxide
Drift-percentage 7:			
	aquatic life	147 points	0 points
	soil life	9 points	100 points
Drift-percentage 1:			
	aquatic life	21 points	0 points
	soil life	9 points	100 points

[*] Leendertse, P.; A. Kool, 2003: Milieubelasting van gewasbescherming in biologische fruitteelt – Basissituatie en twee scenario's. Centrum Landbouw en Milieu, Utrecht. Rapport CLM 571-P-2003.
[♣] M. Trapman (farm adviser): personal communication.

Annex 7 UK Policy context – Timetable

Policy initiative (see section 3.4)	Timetable
3.4.1 EU Pesticides Directive 91/414 Review – particularly 4th stage	All decisions on Annex I of active substances in the fourth list are due to be taken by December 2008
EU Thematic Strategy and the EU 6th Environmental Action Plan	The European Commission is due to publish its position on the Thematic Strategy on the Sustainable Use of Pesticides in September 2004
3.4.3 UK National Pesticides Strategy (Defra, Pesticide Safety Directorate) 3.4.4 PSD Small Business Champion	A draft Strategy may be available for consultation in May 2004 Ongoing
3.4.5 PSD pilot project on registration of biological products	Ongoing, due for review mid 2004
PSD research on regulation of pheromone products	Research should be completed in 2004
Advisory Committee on Pesticides sub-group report: Alternative approaches to chemical pesticides	The Committee has published a draft final report in November 2003. Revisions to be expected in 2004
3.4.8 FSA residue minimisation policy	The FSA Board will discuss the policy at its May 2004 meeting
3.4.9 Cabinet Office Better Regulation biopesticide engagement	The final report was published in January 2004. No further work is planned at present
3.4.10 European Action Plan for Organic Food and Farming	In early 2004, the Commission will prepare the final Action Plan in the form of a Communication to the Council and the European Parliament.
3.4.11 UK Organic Action Plan	Published in 2002 and implementation is ongoing

ANNEX 8: Pesticides used in organic farming – safety overview

a) Substances of crop or animal origin

Pesticide	Description	PAN database assessment	Comments
Azadirachtin (Neem tree extract)	Insecticide	Acute toxicity: Severe skin and gastrointestinal irritation; CNS stimulation and depression have been observed (U.S. EPA 1999) Phytotoxic Fish: slight toxicity Insects: moderate toxicity	Toxicity class: EPA (formulation) IV; III (undiluted**)** Mild to slightly irritating (U.S. EPA, 1993) Mice and rats: reversible male anti-fertility activity without inhibition of spermatogenesis (Sadre N.L. *et al.*,1983) Trang Dang Xuan *et al*., (2004 LC50 for rainbow trout 0.48 mg/l (AgriDyne Technol. Inc., 1995), “highly toxic” (Kamrin M.A., 1997); formulated product Azatin-EC not expected to kill fish at recommended rates, may cause significant fish kill if large concentrations reach waterways (Martineau, 1994) Bees: insect-growth-regulating effects (for high concentrations and small hives, National Research Council, 1992)
Beeswax*	Pruning agent	No adverse effects listed	Repeated exposure may cause skin irritation or sensitisation (Chemical Database)
Hydrolysed protein*	Attractant	No adverse effects listed	May cause mild skin irritation (Chemical Database)
Lecithin	Fungicide	No adverse effects listed	
Nicotine (Extract from *Nicotiana tabacum)*	Insecticide	Acute toxicity: high; developmental or reproductive toxin Fish: moderate toxicity	Toxic if swallowed; very toxic in contact with skin (EC Risk Phrase) Toxicity class: WHO (a.i.) Ib, EPA (formulation) I Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment (Chemical Database)

			Birds: toxic (Copping, 2001) Bees: toxic but repellent (Tomlin, 2003)
Nicotine sulphate		No available assessment of acute toxicity; Developmental or reproductive toxin Fish: slight to moderate toxicity	May be fatal if swallowed or absorbed through the skin, may cause irritation of digestive tract and skin, or CNS stimulation (Chemical Database)
Plant oils and extracts	Insecticide,acaricide, fungicide, repellent and sprout inhibitor		Includes a large group of at least 18 different chemical oils and extracts
Citronella oil (citronellol)	Repellent	Fish: slight toxicity	
Citrus extract & grapefruit seed extract		No adverse effects listed	
Clove oil	Insect repellent	No adverse effects listed	
Daphne oil	Insect repellent, insecticide	No adverse effects listed	
Eucalyptus oil		Acute toxicity: slight	
Garlic extract	Repellent	Acute toxicity: Slight	
Garlic oil	Anthelmintic	No summary assessment available	
Lemongrass oil	Insect repellent, insecticide.	No adverse effects listed	
Olive oil		No adverse effects listed	

Orange oil	Insect, dog, cat repellent, insecticide	No adverse effects listed	
Pepper	Insecticide, deer repellent	No summary assessment available	
Pine oil (Oil of pine tar)	Insecticide, microbiocide	Irritant, potential allergen; No summary assessment available	Irritation of the mucous membranes and gastrointestinal tract; mild respiratory and CNS depression and renal toxicity; aspiration pneumonia; in larger doses severe respiratory distress, cardiovascular collapse, severe CNS effects, renal failure, and myoglobinuria (U.S. EPA, 1999, ch. 9)
Quassia	Insecticide	Fish: slight toxicity	
Rape seed oil (Canola oil)	Insecticide, repellent, adjuvant	No adverse effects listed	
Seaweed			
Soya oil (Soybean oil)	Insecticide, adjuvant	Acute toxicity: slight	
Spearmint oil		Acute toxicity: slight	
Sunflower seed oil	Bait	No adverse effects listed	
Thyme oil	Insect repellent, insecticide	No adverse effects listed	
Ylang-Ylang oil (Cananga oil)		No adverse effects listed	

Pyrethrins	Insecticide	**PAN Bad Actor** Acute toxicity: slight Irritation of skin, eyes and respiratory tract; sensitizer (may cause aller-gic reactions).	Concerns have been raised because pyrethrins have been classified by the US EPA as an L2 carcinogen = Likely to be carcinogenic to humans, available tumour effects and other key data are adequate to demonstrate carcinogenic potential for humans. (EPA, 2000) Synthetic pyrethroid compounds vary in their toxicity as do the natural pyrethrins (Occupational Health Services, Inc., 1987) Many of the natural and synthetic compounds can produce skin irritation (Aldridge W.N., 1990) Birds: slightly toxic (Elliot,1972) Fish: highly toxic (Copping, 2001) Bees: highly toxic but repellent effect (Copping,2001)
Kieselguhr = Diatomaceous earth	Insecticide, moluscicide	Acute toxicity: slight	
Rotenone	Insecticide	Moderately toxic Fish: highly toxic (avg.); moderate to very high toxicity (pure or formulation)	The acute oral LD_{50} for rats is 132-1,500 mg/kg making it Moderately Toxic according to the WHO classification (it is very toxic to pigs) (Tomlin, 2003). Betarbet et al (2001) reported a rodent study that linked exposure of rotenone to the development of Parkinson's disease. May be more toxic when inhaled than when ingested; may be harmful when inhaled or absorbed; irritating to eyes, skin and respiratory system (Chemical Database) Studies in rats and hamsters have provided limited evidence for carcinogenic activity; the evidence for carcinogenicity is inconclusive (National Toxicology Program ,1984) Bees: very toxic in combinations with pyrethrum (Copping, 2001)

b) Micro-organisms used for biological control

Pesticide	Description	PAN database assessment	Comments
Bacillus sphaericus	Insecticide	No adverse effects listed	
Beauveria bassiana	Insecticide	No summary assessment available	Possible irritant to eyes, skin and, respiratory system (Copping, 2001)
Beauveria brongniartii	Insecticide	No summary assessment available	Rabbits: mildly irritant to skin
Bacillus thuringiensis	Insecticide	No adverse effects listed	To date, no known mammalian health effects have been demonstrated in any infectivity/pathogenicity study. Some strains of *Bacillus thuringiensis* have the potential to produce various toxins that may exhibit toxic symptoms in mammals, however the manufacturing process includes monitoring to prevent these toxins from appearing in products (EPA, 1998).
Cydia pomonella granulosis virus	Plant growth regulator	No adverse effects listed	Mammals: no evidence of acute or chronic toxicity and eye irritation; no allergic reactions; Fish: not acutely toxic (Copping, 2001)
Metarhizium anisopliae, various strains	Insecticide	No adverse effects listed	Mammals: no allergic or other adverse toxicological effects reported; Non-target organisms: no adverse effects reported (Copping, 2001)
Neodiprion sertifer nucleo-polyhedrovirus	Insecticide	No adverse effects listed	(as above)

Phlebiopsis gigantea	Fungicide	No adverse effects listed	
Streptomyces griseoviridis	Fungicide	No adverse effects listed	
Trichoderma, various strains	Fungicide	No adverse effects listed	Mammals: no known health risks, not toxic; Non-target organisms: no known risks (Copping, 2001)
Verticillium dahliae	Fungicide	No adverse effects listed	(for *V. lecanii*): as above (Copping, 2001)

c) Substances used in traps and/or dispensers

Pesticide	**Description**	**PAN database assessment**	**Comments**
Diammonium phosphate (Ammonium phosphate, dibasic)	Attractant	Fish: slightly toxic (avg.), slight to high toxicity	May be irritating (NFPA rating for health: 1)
Metaldehyde	molluscicide	Moderate toxicity and potential to contaminate groundwater	The acute oral LD_{50} for rats is 283 mg/kg making it Moderately Toxic according to the WHO classification. It is non-mutagenic, and non teratogenic (Tomlin, 2003). The US EPA has classified metaldehyde as a Restricted Use Pesticide because of its potential short term and long-term effects on wildlife. (U.S. EPA, 1988) The Californian Department for Pesticide Regulation considers metaldehyde to have the potential to move into groundwater based on criteria such as its water solubility, ability to bind to soils (K_{oc}), and half-life. Fish: LC50 (96 h) for rainbow trout 75 mg/l (Tomlin 2003), slightly toxic (Kamrin, 1997)
Pheromones	Attractant, sexual behaviour	No adverse effects listed	Includes a group of chemicals active at low concentrations; generally specific to target insect

	disruptor		(Copping, 2001)
Pyrethroid: Deltamethrin	Insecticide	Moderate toxicity Fish: highly toxic (avg.), moderate to very high toxicity	The acute oral LD_{50} for rats is 135-1,500 mg/kg making it Moderately Toxic according to the WHO classification
Pyrethroid: lambda - Cyhalothrin		Moderate toxicity, and possible endocrine disrupter Fish: very high toxicity	A list of suspected endocrine disrupting (ED) chemicals (including lambda-cyhalothrin) was published in the scientific literature (Colborn *et al*.,1993), however, there are currently no authoritative regulatory lists of ED chemicals **Bees: very high toxicity** (Tomlin, 2003)

d) Other substances from traditional use in organic farming

Pesticide	**Description**	**PAN database assessment**	**Comments**
Copper salts (copper hydroxide, copper oxychloride, copper sulphate and cuprous oxide)	Fungicide	Acute toxicity: slight Irritation of skin, eyes, respiratory tract; corrosive to mucous membranes and the cornea Fish: moderate to very high toxicity (dep. on type of salt)	Possible impact on earthworms after prolonged use in perennial cropping (e.g. vineyards). Copper sulphate is caustic and acute toxicity is largely due to this property (U.S. Nat. Library of Medicine 1995) Soluble salts, notably copper sulphate, are strong irritants to skin, mucous membranes (Budavari 1989) Copper oxychloride: toxic (Chemical Database)
Ethylene	Degreening	Acute toxicity:	Asphyxiant, high concentrations

	bananas	high, developmental or endocrine toxin **(PAN Bad Actor)** Fish: mortality effects noted	cause narcosis (Budavari, 1989)
Fatty acid potassium/sodium salt (soft soap)	Insecticide	No adverse effects listed	Bees: LC50 (contact) >0.025 mg/bee (Copping, 2001)
Potassium alum (kalinite)	Prevention of ripening bananas	No adverse effects listed	
Limesulphur (calcium oxysulphide, lime sulfurated solution)	Fungicide, insecticide, acaricide	Acute toxicity: No adverse effects listed Fish: slight to moderate tox.	
Paraffin oil (white mineral oil)	Insecticide, acaricide	No adverse effects listed	
Mineral oil (petroleum)	Insecticide, fungicide	Acute toxicity: slight Fish: no acute toxicity; mortality effects noted	cf. *Kerosene*: defatting action on skin can lead to irritation, infection; inhalation of high concentrations causes headache, drowsiness, coma; swallowing causes G.I. irritation with vomiting, diarrhoea. (Budavari, 1989)
Potassium permanganate	Fungicide, bactericide		Dilute concentrations mildly irritating, high concentrations caustic (Budavari, 1989)
Quartz sand (Silicon dioxide)	Repellent		Prolonged inhalation of dust can cause fibrosis of the lung, silicosis (Budavari, 1989)
Sulphur	Fungicide, acaracide, repellent		May cause irritation of skin, mucous membranes (Budavari 1989)

* In some Member States these products are not considered plant protection products (PPP) and are not subject to PPP Regulations.

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