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AUTHENTICATION

We declare that this work was done under our supervision according to the procedures described herein and that the report represents a true and accurate record of the results obtained.

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Grower Summary

Headline

- In the UK there are 15 biopesticides *products* registered, compared to 77 *active substances* in the EU and approximately 279 in the USA. Globally, there are many biopesticide products with real potential for pest and disease management in UK field vegetable crops but their product development in the UK is hampered.
- Despite recent improvements, registration and the generation of data for registration are still the most significant hurdles for biopesticide development.

Background and expected deliverables

There are several drivers promoting interest in biopesticides as crop protection agents;

- loss of active ingredients due to changes in the EU Plant Protection Product Regulation
- a need to have produce with no detectable chemical pesticide, extending to development of zero residue crops,
- to have additional tools to support resistance management,
- continued development of sustainable production methods, including in response to the EU thematic strategy – for safer sustainable food production, and
- for use as part of Integrated Pest/Crop Management (IP/CM) crop protection.

However, few biopesticide products are available to UK field vegetable growers: this project aimed to provide UK vegetable growers with information about biopesticides, and their potential for use as part of robust integrated crop protection protocols that support vegetable production systems. It was intended that this information could be used to develop policies and strategies on biopesticides to encourage streamlining the registration and marketing of the products needed by growers. These aims were addressed through liaison with key grower associations, relevant trade associations and supermarkets. In addition, information was obtained from links with UK and European regulators and relevant biopesticide companies and distributors to ascertain product availability and ways to encourage an increase in biopesticide product availability for the UK.

The information gathered is summarised in a series of databases;

1. List of active ingredients and products currently registered in the UK and non-registered biopesticides permitted for use in UK (Tables 5 & 6).
2. List of companies producing and distributing biopesticides available in UK (Table 7).
3. List of active ingredients registered in EU (Table 8).

4. Cross-referencing of six crop groups (Brassicacae, carrots, herbs, leafy salads, onions, peas and beans) with UK available biopesticides plus, indicating potential products, that is those listed in the EU but not yet registered in UK (Tables 9 to 14).

In the USA there are over 279 biopesticide active substances registered compared to 77 in the EU and 15 in the UK. The US has had a biopesticide-specific registration system in place for over 20 years and it seems obvious that the large differences in product availability must, in part, be because registration constitutes a hurdle to biopesticide product availability. There are other factors contributing to the disparity between the US and Europe including, the European biopesticide industry is younger and, the EU markets are highly fragmented but also because in the US there is specific government support for development of biopesticide capacity particularly for use on minor crops, through the IR-4 programme.

Summary of the project and main conclusions

There is no standardised definition of what constitutes a biopesticide. However, in the UK, 'biopesticide' generally includes products with active substances based on: micro-organisms, botanicals (or biochemicals or plant extracts) and semio-chemicals (including pheromones) and an additional category of 'other' which is judged on a case-by-case basis. As for chemical plant protection products, biopesticides are regulated under the Council Directive 91/414/EEC and subsequent amendments. This means the *active substance* is registered at the EU level and then *products* registered in member states (Figure 1). The registration process of both active and product takes on average 5 years (range of 2-10 years).

Biopesticides are used as crop protection products in conventional agriculture and horticulture; as standalone products, in Integrated Pest Management programmes and in organic crop production. Across Europe, there has been increasing retailer (and consumer) pressure on growers to reduce chemical pesticide residues on fresh produce, often to below the levels recommended and enforced by the European authorities. A new Legislative framework came into force in Europe on 1 September 2008 on pesticide residues (Regulation (EC) 396/2005,) and yet retailers are demanding crop residue levels below those recommended in this new legislation. So, to remain competitive with buyers and keep their markets, growers need to produce food without detectable chemical pesticide residues. Therefore, biopesticides are often considered as suitable alternatives; in many cases, due to their mode of action, their use will not result in the presence of significant residues.

Biopesticides available in the UK are summarised in Tables 1 and 2 and given in full detail in Tables 5 and 6, including distributors. The table of non-registered products lists those that are exempt from registration requirements. In addition to the products listed below there are

some products, for example based on micro-organisms which, do not make any crop protection claims so do not have to be registered and have not been listed. These types of products are not considered in this project.

Table 1. Registered biopesticide available in the UK (April 2009).

Active Substance	Product Name	Type of product	Target(s)
(E,E)-8,10-dodecadien-1-ol	Exosex CM	Pheromone	Codling moth
<i>Bacillus subtilis</i> QST713	Serenade ASO	Bacteria	Botrytis
<i>Bacillus thuringiensis</i> var <i>kurstaki</i>	DiPel DF	Bacteria	Lepidoptera pests
<i>Beauveria bassiana</i> ATC74040	Naturalis-L	Fungus	Whitefly, thrips, spidermite
<i>Candida oleophila</i> Strain O	Nexy1	Yeast	Post harvest diseases
<i>Coniothyrium minitans</i> Strain CON/M/91-08	Contans WG	Fungus	Sclerotinia
<i>Cydia pomonella</i> Granulosis Virus	Cyd-X	Granulosis virus	Codling moth
<i>Cydia pomonella</i> Granulosis Virus	Cyd-X Extra	Granulosis virus	Codling moth
Fatty Acids	Savona	Fatty Acids	Whitefly, thrips, spidermite, aphid
Laminarin	Vacciplant	Plant extract/glucan	Cereal diseases
<i>Lecanicillium muscarium</i> (formerly <i>Verticillium lecanii</i>)	Mycotal	Fungus	Whitefly, thrips, scale insects, mealybug
<i>Lecanicillium muscarium</i> (formerly <i>Verticillium lecanii</i>)	Vertalec	Fungus	Aphids
<i>Peniophora gigantea</i>	PG Suspension	Bacteria	PGR
Plant oils_citronella oil	Barrier H	Herbicide	Weeds
<i>Zucchini</i> Yellow Mosaic Virus Weak Strain	Curbit	Plant virus	plant viruses

Table 2. Non-registered biopesticide products available in the UK (April 2009).

Active Substance	Product Name	Type of product	Target(s)
<i>Steinernema feltiae</i>	Nemasys	Entomopathogenic nematode	Sciarids, leafminer, WFT
<i>Steinernema kraussei</i>	Nemasys L	Entomopathogenic nematode	vine weevil
<i>Heterorhabditis megidis</i>	Nemasys H	Entomopathogenic nematode	vine weevil,
<i>Heterorhabditis megidis</i>	Lavanem	Entomopathogenic nematode	Vine weevil
<i>Heterorhabditis megidis</i>	Nemasys H	Entomopathogenic nematode	Grubs
<i>Steinernema carpocasae</i>	Nemasys C	Entomopathogenic nematode	codling moth (occasional cutworms)
<i>Steinernema carpocasae</i>	Nemasys C	Entomopathogenic nematode	Hylobius sp., Lepidoptera
<i>Steinernema carpocapsae</i>	Capsanem	Entomopathogenic nematode	Lepidoptera
<i>Phasmarhabditis hermaphrodita</i>	Nemaslug	slug parasitic nematode	Slugs
Maltodextrin	Majestik	Other	Aphids
<i>Trichoderma harzianum</i> Rifai (T-22)	Trianum	Micro-organism	Root diseases

A feature of many biopesticides is that they are specific in their target activity therefore; it is likely that growers will need many more products to support growing of field vegetables compared to chemical pesticides. Compared to the active substances available in Europe, 77 (Table 3) and the US, 279 there are relatively few biopesticide registered for use in the UK. The main hurdles to product availability are:

- Registration – in the US where there is a biopesticide (biorational) specific registration system that has been in place over 20 years and a minor uses programme, significantly more products are available than in Europe and UK.
- UK is a small market for many biopesticide products therefore it may not be economic to support a product registration relative to the market value of the product.
- Few products have been available so growers have limited experience with biopesticides and there is a lack of confidence in their efficacy so limiting their uptake.

Table 3. Biopesticide active substances listed on the EU Active Substances list.

	Insecticide	Fungicide	Herbicide	Nematicide	Repellant	Other
Microorganism Bt	5	-	-	-	-	-
Microorganism non-Bt	3	20	0	1	0	1
Botanical	0	0	0	0	2	7
Baculovirus	4	-	-	-	-	-
Semio-chemical + pheromone	28	-	-	-	-	-
Other	2	1	1	0	1	1
Total	42	21	1	1	3	9

Table 4. Biopesticide active substances available in USA, April 2009.

	Insecticide	Fungicide	Herbicide	Nematicide	Repellant	Other
Microorganism Bt	44	-	-	-	-	-
Microorganism non-Bt	11	41	5	3	0	1
Botanical	8	6	1	2	28	1
Baculovirus	7	-	-	-	-	-
Semio-chemical + pheromones	56	-	-	-	-	-
Other	25	8	3	0	8	21
Total	151	55	9	5	36	23

Biopesticide Gaps

The most obvious gap for all field vegetable crop groups is that in the UK there is only one bio-herbicide, this is not an issue specific to the UK but a general feature of biopesticides globally, there are few bio-herbicides available. This may well be driven by the low cost margins for these types of products, making biopesticide development economically unfeasible. The one product that is available, Barrier H, does not seem to be distributed at present in the UK. Equally there are few nematicides available.

The limited range of UK available biopesticide products (Table 1 and 2) means that for most of the pest and disease groups relevant to UK vegetables, there are few products available the exceptions are for some fungal disease such as *Sclerotinia* spp. and *Botrytis* spp., for Lepidopterous larvae and some sucking pests (aphids and thrips). However, there are many new products in the process of being registered in the UK which will become available shortly these include products active against fungal and bacterial diseases and insect pests.

Considering the list of active substances available in Europe it is reasonable to assume that there is potential for an increase in biopesticide product availability in the UK, provided manufacturers consider it financially viable to register here. Also, there is an increase in US based biopesticide companies starting to register active substances in Europe, although it may take several years before they are available to growers, there is reason to be optimistic.

Specific details of biopesticides available for each of the field vegetable crop groups, is provided in the cross-referencing tables in Tables 9 to 14. Details of UK-active producers or distributors associated with these products are given in Table 7.

Conclusions

- In the UK there are 15 biopesticide *products* registered, compared to 77 *active substances* in the EU and approximately 279 in the USA.
- With few products available, UK field vegetable growers currently have no access to biopesticides for weed control and there are significant gaps in the availability of biopesticides for insect, nematode and disease management.
- Biopesticide product availability in the UK is increasing, but it seems that this is at a rate that may be too slow to meet grower's needs unless additional actions are taken.
- Product registration still represents the greatest hurdle to biopesticide product availability.
- The limited target specificity of many biopesticide products means their potential markets are highly fragmented often making new product developments non-viable.
- If a product makes any claim as a plant protection agent, that is it reduces the incidence of invertebrates, diseases or weeds, it must be registered under 91/414/EEC and its recent amendments.

Financial benefits

The changes to the EU plant protection regulatory system means there is a real possibility of less crop protection options in future, a serious threat to horticultural food production in UK and economic production of field vegetables. Biopesticides will be of increasing significance in helping sustain production.

Recommended actions to improving biopesticide availability and use:

- Need government supported capacity building within relevant UK bodies to increase their ability to deal with biopesticide registrations. Good examples are provided by US regulators, such as the 'EPA Biorational registration system' and 'IR-4 programme'.
- Improved support of companies registering biopesticide products, for example the GENOEG project in Netherlands (www.genoeg.nl).

- Increased government support for the mainly SME biopesticide companies to develop these types of products that support sustainable agriculture.
- Establishment of forum for crop groups with similar pest or disease problems to collaborate to identify biopesticide product needs and to link to relevant producers and distributors to facilitate biopesticide availability.
- Improve information sources about biopesticide products and their availability.
- Development of specialist biopesticide product distributors in UK able to provide detailed and accurate biopesticide product knowledge.
- Support for work on implementation of biopesticides; guidance on features, development of use programmes, improve knowledge on field delivery using existing equipment.

Action points for grower groups

- Engagement with biopesticide manufacturers and distributors to:
 - Encourage and facilitate grower-based evaluation trials to determine effective products most suited to their specific crop protection needs,
 - Support product registrations through provision of linked marketing groups.
- Promote the need to government for biopesticides and for resources being made available to regulators to streamline registration of required products and to increase capacity to support policy initiatives such as the OECD Biopesticide Steering group and cross EU dialogue to facilitate biopesticide guidance document development.

Relevant Links

1. UK regulatory authority: Chemicals Regulation Directorate -Pesticides (formerly Pesticides Safety Directorate) – biopesticide information pages:

www.pesticides.gov.uk/biopesticides_home.asp

2. USA regulatory authority biopesticide web pages:

www.epa.gov/pesticides/biopesticides/#factsheet

3. EU plant protection databases including lists of active substances:

http://ec.europa.eu/food/plant/protection/evaluation/index_en.htm

4. US programme to support minor uses:

(IR-4 programme: <http://ir4.rutgers.edu>)

5. Legislation on new MRL regulations

http://ec.europa.eu/food/plant/protection/pesticides/index_en.htm

6. International Biocontrol Manufacturers Association

www.ibma.ch

7. Biopesticide Industry Association (US)

www.biopesticideindustryalliance.org

Table 5: List of UK Biopesticide Products - Registered

Active Substance	Product Name	Type of product	Target(s)	SOLA	Annex I listed	Producer	Distrbutor	Comments
(E,E)-8,10-dodecadien-1-ol	Exosex CM	Pheromone	Codling moth	No	Yes	Exosect Ltd.	Exosect Ltd	
<i>Bacillus subtilis</i> QST713	Serenade ASO	Bacteria	Botrytis	Yes	Yes	Agraquest Inc.	Fargro Ltd. Syngenta Bioline Ltd.	
<i>Bacillus thuringiensis</i> var <i>kurstaki</i>	DiPel DF	Bacteria	Lepidoptera pests	Yes	Yes	Sumitomo Chemical Agro Europe SA	Fargro Ltd. Interfarm UK Ltd.	
<i>Beauveria bassiana</i> ATC74040	Naturalis-L	Fungus	Whitefly, thrips, spidermite	No	Yes	Intrachem Bio	Belchim Crop Protection Limited	
<i>Candida oleophila</i> Strain O	Nexy1	Yeast	Post harvest diseases	No	Pending	BioNext sprl	BioNext sprl	
<i>Coniothyrium minitans</i> Strain CON/M/91-08	Contans WG	Fungus	Sclerotinia	No	Yes	Prophyta Biologischer Pflanzenschutz	Fargro Ltd., Belchim Crop Protection Ltd.	Registered under COPR in UK
<i>Cydia pomonella</i> Granulosis Virus	Cyd-X	Granulosis virus	Codling moth	No	Yes	Certis Europe BV	Certis Europe BV	
<i>Cydia pomonella</i> Granulosis Virus	Cyd-X Extra	Granulosis virus	Codling moth	No	Yes	Certis Europe BV	Certis Europe BV	
Fatty Acids	Savona	Fatty Acids	Whitefly, thrips, spidermite, aphid	Yes	?	Koppert B.V.	Koppert B.V.	
Laminarin	Vacciplant	Plant extract/glucan	Cereal diseases	No	Yes	Goemar SA	Goemar SA	
<i>Lecanicillium muscarium</i> (formerly <i>Verticillium lecanii</i>)	Mycotal	Fungus	Whitefly, thrips, scale insects, mealybug	Yes	Yes	Koppert B.V.	Koppert B.V., Fargro Ltd.	Registered under COPR in UK
<i>Lecanicillium muscarium</i> (formerly <i>Verticillium lecanii</i>)	Vertalec	Fungus	Aphids	Yes	Yes	Koppert B.V.	Koppert B.V., Fargro Ltd.	Registered under COPR in UK
<i>Peniophora gigantea</i>	PG Suspension	Bacteria	PGR	No	No	Forestry Commission	Forest Research	Registered under COPR
Plant oils_citronella oil	Barrier H	Herbicide	Weeds	No	Yes	Barrier Biotech Ltd	Barrier Biotech Ltd	
<i>Zucchini</i> Yellow Mosaic Virus Weak Strain	Curbit	Plant virus	plant viruses	No	Pending	Bio-Oz Biotechnologies Ltd	Bio-Oz Biotechnologies Ltd	Registered under COPR in UK

Table 6: List of UK Biopesticide Products - Non Registered

Active Substance	Product Name	Type of product	Target(s)	Licence	Producer	Distrbutor
<i>Steinernema feltiae</i>	Nemasys	Entomopathogenic nematode	Sciarids, leafminer, WFT	UK isolate	Becker Underwood	Syngenta bioline, BCP, Hutchinsons, Avoncrop, Fargro, UAP, JF McKenna, Sylvan
<i>Steinernema kraussei</i>	Nemasys L	Entomopathogenic nematode	vine weevil	UK isolate	Becker Underwood	Syngenta bioline, BCP, Hutchinsons, Avoncrop, Fargro, UAP, JF McKenna
<i>Heterorhabditis megidis</i>	Nemasys H	Entomopathogenic nematode	vine weevil,	UK isolate	Becker Underwood	Syngenta bioline, BCP, Hutchinsons, Avoncrop, Fargro, UAP, JF McKenna
<i>Heterorhabditis megidis</i>	Lavanem	Entomopathogenic nematode	Vine weevil		Koppert BV	Koppert UK
<i>Heterorhabditis megidis</i>	Nemasys H	Entomopathogenic nematode	Grubs	UK isolate	Becker Underwood	Scotts
<i>Steinernema carpocasae</i>	Nemasys C	Entomopathogenic nematode	codling moth (occasional cutworms)	UK isolate	Becker Underwood	Agrovista
<i>Steinernema carpocasae</i>	Nemasys C	Entomopathogenic nematode	Hylobius	UK isolate	Becker Underwood	Forestry product
<i>Steinernema carpocapsae</i>	Capsanem	Entomopathogenic nematode	Lepidoptera		Koppert BV	Koppert UK
<i>Phasmarhabditis hermaphrodita</i>	Nemaslug	slug parasitic nematode	Slugs	UK isolate	Becker Underwood	Syngenta bioline, BCP, Hutchinsons, Avoncrop, Fargro, UAP, JF McKenna, Branstons, Procarn, Wallace of Kelso
Maltodextrin	Majestik	Other	Aphids	N/A	Certis LLC	Certis Europe BV
<i>Trichoderma harzianum</i> Rifai (T-22)	Trianum	Micro-organism	Root diseases		BioWorks Inc.	Koppert UK

Table 7: List of UK Active Biopesticide Producers and Distributors

Company	Country	Website	Comments
Agraquest Inc.	USA	www.Agraquest.com	
Agrauxine	FR	www.agrauxine.fr	
Agrifutur s.r.L.	IT	www.agrifutur.com	
Agro Green	Israel	www.agrogreen.co.il	
Becker Underwood Inc.	USA, UK	www.beckerunderwood.com	
Belchim Crop Protection Ltd.	BE, UK, ES, IT, HU	www.belchim.com	
BioNext sprl	BE		Post harvest products
Bio-Protect GmbH	DE	www.bio-protect.de	
Bioworks Inc.	USA	www.bioworksbiocontrol.com	
Certis LLC	USA, UK	www.certis.com	
Ecospray Ltd.	UK	www.ecospray.com	
E-Nema GmbH	DE	www.e-nema.de	
Exosect Ltd.	UK	www.exosect.com	
Fargro Ltd	UK	www.fargro.co.uk	
Futureco S.L	ES	www.futureco.net	
Intrachem Bio S.r.L	IT, FR	www.intrachem.it	
Intrerfarm (UK) Ltd.	UK	www.interfarm.co.uk	
Koppert B.V.	NL	www.koppert.nl	
Novozymes Biologicals Inc.	USA, EU	www.novozymes.com	
Prophyta GmbH	DE	www.prophyta.de	
Vedera Oy	FI	www.verdera.fi	
W. Neudorff GmbH KG	DE	www.neudorff.de	
www.sourcon-padena.de			Pseudomonas sp. Starin DSMZ 13134
Xeda International		www.xeda.com	Plant oils for post harvest

Table 8: List of EU Active Substances

EU Active PPP March 2009	Category ^a	Annex I 91/414	*RMS ^b	MRLs Reg 396/2005
<i>Bacillus thuringiensis</i> subsp. <i>Aizawai</i> (ABTS-1857 and GC-91)	IN	In	IT	
<i>Bacillus thuringiensis</i> subsp. <i>Israelensis</i> (AM65-52)	IN	In	IT	
<i>Bacillus thuringiensis</i> subsp. <i>Kurstaki</i> (ABTS 351, PB 54, SA 11, SA12 and EG 2348)	IN	In	DK	
<i>Bacillus thuringiensis</i> subsp. <i>Tenebrionis</i> (NB 176)	IN	In	IT	
<i>Beauveria bassiana</i> (ATCC 74040 and GHA)	IN	In	DE	
<i>Cydia pomonella granulosis virus</i> (CpGV)	IN	In	DE	
<i>Lecanicillium muscarium</i> (Ve6) (former <i>Verticillium lecanii</i>)	IN	In	NL	
<i>Metarhizium anisopliae</i> (BIPESCO 5F/52)	IN	In	NL	
<i>Phlebiopsis gigantea</i>	FU	In	EE	
<i>Pythium oligandrum</i> (M1)	FU	In	SE	
<i>Streptomyces griseoviridis</i> (K61)	FU	in	EE	
<i>Trichoderma atroviride</i> (IMI 206040) (T 11) (former <i>Trichoderma harzianum</i>)	FU	In	SE	
<i>Trichoderma harzianum</i> Rifai (T-22)	FU	In	SE	
<i>Trichoderma polysporum</i> (IMI 206039)	FU	In	SE	
<i>Trichoderma gamsii</i> (formerly <i>T. viride</i>) (ICC080)	FU	In	FR	
<i>Verticillium dahliae alboatrum</i> (WCS850) (formerly <i>Verticillium dahliae</i>)	FU	In	NL	
Acetic acid	HB	In	DE	Reg. 839/2008
Blood meal	RE	In	BE	Reg. 839/2008
Extract from tea tree	RE	In	LV	Reg. 839/2008
Oleic acid (CAS 112-80-1)		In	IE	

EU Active PPP March 2009	Category^a	Annex I 91/414	*RMS^b	MRLs Reg 396/2005
Pelargonic acid (CAS 112-05-0)		In	IE	
Garlic extract	RE	In	PL	Reg. 839/2008
Hydrolysed proteins	IN	In	EL	
Kieselguhr (diatomaceous earth)	IN	In	EL	Reg. 839/2008
Pepper	RE	In	HU	Reg. 839/2008
Plant oils / Citronella oil	HB	In	UK	Reg. 839/2008
Plant oils / Clove oil	RE	In	UK	Reg. 839/2008
Plant oils / Rape seed oil		In	ES	Reg. 839/2008
Plant oils / Spearmint oil		In	SE	Reg. 839/2008
Sea-algae extract (formerly sea-algae extract and seaweeds)	PG	In	IT	Reg. 839/2008
Straight Chain Lepidoptera Pheromones:	AT	In	AT	
Dodecyl acetate	AT	In	AT	
(E)-5-Decen-1-yl acetate	AT	In	AT	
(E)-8-Dodecen-1-yl acetate	AT	In	AT	
(E/Z)-8-Dodecen-1-yl acetate	AT	In	AT	
(Z)-8-Dodecen-1-yl acetate	AT	In	AT	
(Z)-9-Dodecen-1-yl acetate	AT	In	AT	
(7E, 9E)-Dodecadien 1-yl acetate	AT	In	AT	
(7E, 9Z)-Dodecadien 1-yl acetate	AT	In	AT	
(Z)-11-Hexadecen-1-yl acetate	AT	In	AT	
(7Z, 11E)-Hexadecadien-1-yl acetate	AT	In	AT	
(7Z, 11Z)-Hexadecadien-1-yl acetate	AT	In	AT	

EU Active PPP March 2009	Category ^a	Annex I 91/414	*RMS ^b	MRLs Reg 396/2005
(2E, 13Z)-Octadecadien-1-yl acetate	AT	In	AT	
(E)-11-Tetradecen-1-yl acetate	AT	In	AT	
(Z)-9-Tetradecen-1-yl acetate	AT	In	AT	
(Z)-11-Tetradecen-1-yl acetate	AT	In	AT	
(9Z, 12E)-Tetradecadien-1-yl acetate	AT	In	AT	
(E)-5-Decen-1-ol	AT	In	AT	
(Z)-8-Dodecen-1-ol	AT	In	AT	
(E,E)-8,10-Dodecadien-1-ol	AT	In	AT	
Tetradecan-1-ol	AT	In	AT	
(Z)-11-Hexadecen-1-ol	AT	In	AT	
(Z)-7-Tetradecenal	AT	In	AT	
(Z)-9-Hexadecenal	AT	In	AT	
(Z)-11-Hexadecenal	AT	In	AT	
(Z)-13-Octadecenal	AT	In	AT	
(Z)-13-Hexadecen-11yn-1-yl acetate	AT	In	AT	
(Z,Z,Z,Z)-7,13,16,19-Docosatetraen-1-yl isobutyrate	AT	In	AT	
<i>Ampelomyces quisqualis</i> strain AQ10	FU	In	FR	Reg. 149/2008
<i>Bacillus subtilis</i> str. QST 713	BA, FU	In	DE	Reg. 149/2008
<i>Coniothyrium minitans</i>	FU	In	DE	Reg. 149/2008
<i>Gliocladium catenulatum</i> strain J1446	FU	In	FI	Reg. 839/2008
<i>Paecilomyces fumosoroseus</i> Apopka strain 97	FU	In	BE	Reg. 149/2008
<i>Paecilomyces lilacinus</i>	FU	In	BE	
<i>Pseudomonas chlororaphis</i> strain MA342	IN	In	SE	Reg. 149/2008

EU Active PPP March 2009	Category ^a	Annex I 91/414	*RMS ^b	MRLs Reg 396/2005
<i>Spodoptera exigua nuclear polyhedrosis virus</i>	FU	In	NL	
<i>Adoxophyes orana GV strain BV-0001</i>	IN	pending	DE	
Ascorbic acid	FU	pending	NL	
<i>Aureobasidium pullulans</i>	FU, BA	pending	AT	
<i>Candida oleophila strain O</i>	FU	pending	UK	
<i>Helicoverpa armigera nucleopolyhedrovirus (HearNPV)</i>	IN	pending	EE	
<i>Paecilomyces fumosoroseus strain Fe9901</i>	NE	pending	BE	
<i>Pseudomonas sp. Starin DSMZ 13134</i>		pending	NL	
<i>Pseudozyma flocculosa</i>	FU	pending	NL	
<i>Spodoptera littoralis nucleopolyhedrovirus</i>	IN	pending	EE	
<i>Trichoderma atroviride starin I-1237</i>	FU	pending	FR	
<i>Zucchini Yellow Mosaik Virus, weak strain</i>	FU	pending	UK	

Abbreviations as follows:

- ^a - AC = acaricide,
 FG = fungicide,
 HB = herbicide,
 IN = insecticide,
 NE = nematocidal,
 PG = plant growth regulator;
 RE = repellent,
 RO = rodenticide,

*RMS = Rapporteur Member States

^b – IT = Italy, DK = Denmark, NL= Netherlands, EE = Estonia, SE = Sweden, FR = France, BE= Belgium, LV = Latvia, IE = Ireland, PL = Poland, EL = Greece, HU = Hungary, UK = United Kingdom,

ES = Spain, FI = Finland.

Table 9: Biopesticide Gap Assessment for Brassica Crops

Target Organism Common	Target organism Scientific name	UK - registered		SOLA	UK non-registered ^		UK Distributor	Manufacturer	EU registered - listed active	EU product	Comments
		Active name	Product		Active	Product					
Cabbage root fly	<i>Delia brassicae</i>							Ecospray Ltd	Garlic Extract	EcoGuard	
Cabbage aphid/mealy grey aphid Peach potato aphid Potato aphid	<i>Brevicoryne brassicae</i>	<i>Lecanicillium muscarium</i> (formerly <i>Verticillium lecanii</i>)	Vertalec	Yes			Fargro Ltd.	Koppert B.V.	<i>Lecanicillium muscarium</i> (formerly <i>Verticillium lecanii</i>)	Vertalec	In UK for protected crops only
	<i>Myzus persicae</i>			N/A	Maltodextrin	Majestik	Certis Europe BV	Certis LLC	Maltodextrin	Pending	
	<i>Macrosiphum euphorbiae</i>							Thermo trilogy	<i>Paecilomyces fumosoroseus</i> (Apopka strain 97, PFR 97 or CG 170, ATCC20874)	unknown	Unknown if still in production as Thermotriology no longer in business
								Novozymes Biologicals Inc.	<i>Metarhizium anisopliae</i> (F52)	Bio1020, Met52,	
								Agrifutur s.r.l	<i>Metarhizium anisopliae</i> (BIPESCO 5)	GranMet WP,	
								Intrachem Bio srl	<i>Beauveria bassiana</i> ATC74040	Naturalis-L	UK registered for whitefly and thrips
								Certis Europe BV	Bioworks Inc.	<i>Beauveria bassiana</i> GHA	Botanigard
DBM Cutworms Cabbage whites Silver Y moth Other Lepidoptera	<i>Plutella xylostella</i> <i>Agrotis</i> spp. <i>Pieris</i> spp.	<i>Bacillus thuringiensis</i> var <i>kurstaki</i>	DiPel DF	Yes			Fargro Ltd., Interfarm (UK) Ltd.	Valent Biosciences Inc.	<i>Bacillus thuringiensis</i> var <i>kurstaki</i>	DiPel DF	Bt Isolate: (ABTS 351, PB 54, SA 11, SA12 and EG 2348)
	<i>Autographa gamma</i>				<i>Steinernema carpocapsae</i>	Nemasys C	Agrovista	Becker Underwood Ltd,			
					<i>Steinernema carpocapsae</i>	Capsanem	Koppert UK Ltd	Koppert B.V.			
					<i>Steinernema carpocapsae</i>	Nematop	Fast Products Ltd.	E-Nema GmbH			
Pollen beetle	<i>Meligethes</i> spp.										

Target Organism Common	Target organism Scientific name	UK - registered		SOLA	UK non-registered ^		UK Distributor	Manufacturer	EU registered - listed active	EU product	Comments
		Active name	Product		Active	Product					
Cabbage stem weevil	<i>Ceutorhynchus quadridens</i>										
Slugs	<i>Deroceras</i> spp.				<i>Phasmarhabditis hermaphrodita</i>	Nemaslug	Syngenta bioline, BCP, Hutchinsons, Avoncrop, Fargro, UAP, JF McKenna, Branstons, Procam, Wallace of Kelso	Becker Underwood Ltd.	N/A		

Clubroot	<i>Plasmodiophora brassicae</i>											
Light leaf spot, Ring spot, Dark leaf spot, Damping off, root rot, black rot, canker	<i>Pyrenopeziza brassicae</i> , <i>Mycosphaerella brassicicola</i> , <i>Alternaria brassicae</i> and <i>Alternaria brassicicola</i> , <i>Pythium</i> spp., <i>Rhizoctonia solani</i> , <i>Phytophthora megasperma</i> , <i>Xanthomonas campestris</i> , <i>Phoma lingam</i>				Trichoderma harzianum Rifai (T-22)	Triatum	Koppert	BioWorks Inc.	Trichoderma harzianum Rifai (T-22)	Root Shield WP or Granules, Triatum	Will be registered in the UK	
							Fargro Ltd.& Syngenta bioline Ltd.	Agraquest Inc.	<i>Bacillus subtilis</i> QST713	Serenade ASO or Max	UK registration for botrytis only	
									Biopreparaty Co. Ltd	<i>Pythium oligandrum</i> (M1)	Polyversum	
									Verdera Oy	<i>Gliocladium catenulatum</i> strain J1446	Gliomix	Seedlings
									Verdera Oy	Streptomyces K61 (K61) (formerly <i>Streptomyces griseoviridis</i>)	Mycostop	
									Unknown	<i>Trichoderma aspellerum</i> (ICC012) (T11) (TV1)	unknown	
									unknown	<i>Trichoderma polysporum</i> (IMI 206039)	unknown	

Target Organism Common	Target organism Scientific name	UK - registered		SOLA	UK non-registered ^		UK Distributor	Manufacturer	EU registered - listed active	EU product	Comments
		Active name	Product		Active	Product					
								unknown	<i>Trichoderma atroviride</i> (IMI 206040) (T 11)	unknown	
								unknown	<i>Trichoderma gamsii</i> (ICC080)	unknown	
Downy Mildew	<i>Peronospora parasitica</i>										
Powdery mildew	<i>Erysiphe cruciferarum</i>						Fargro Ltd.& Syngenta bioline Ltd.	Agraquest Inc.	<i>Bacillus subtilis</i> QST713	Serenade ASO or Max	UK registration for botrytis only
								Intrachem Bio	<i>Ampelomyces quisqualis</i> strain AQ10	AQ10	
White blister	<i>Albugo candida</i>										
Grey mould	<i>Botrytis cinerea</i>	<i>Bacillus subtilis</i> QST713	Serenade ASO	Yes			Fargro Ltd.& Syngenta bioline Ltd.	Agraquest Inc.	<i>Bacillus subtilis</i> QST713	Serenade ASO	
Turnip Mosaic virus	TMV										
Cauliflower Mosaic virus	CMV										
Beet Western Yellows Virus	BWYV										

Table 10: Biopesticide Gap Assessment for Carrot Crops

Target Organism Common name	Target organism Scientific name	UK - registered		SOLA	UK non-registered ^		UK Distributor	Manufacturer	EU registered - listed active	EU product	Comments
		Active	Product		Active	Product					
Carrot fly	<i>Psila rosae</i>										No biopesticides available
Willow Carrot Aphid	<i>Cavariella aegopodii</i>	<i>Lecanicillium muscarium</i> (formerly <i>Verticillium lecanii</i>)	Vertalec	Yes			Fargro Ltd.	Koppert B.V.	<i>Lecanicillium muscarium</i> (formerly <i>Verticillium lecanii</i>)	Vertalec	In UK for protected crops only
				N/A	Maltodextrin	Majestik	Certis Europe BV	Certis LLC	Maltodextrin - pending	Pending	
								Thermo trilogy	<i>Paecilomyces fumosoroseus</i> (Apopka strain 97, PFR 97 or CG 170, ATCC20874)	unknown	Unknown if still in production as Thermotriology no longer in business
								Novozymes Biologicals Inc.	<i>Metarhizium anisopliae</i> (F52)	Bio1020, Met52,	
								Agrifutur s.r.l	<i>Metarhizium anisopliae</i> (BIPESCO 5)	GranMet WP,	
								Intrachem Bio srl	<i>Beauveria bassiana</i> ATC74040	Naturalis-L	UK registered for whitefly and thrips
								Certis Europe BV	Bioworks Inc.	<i>Beauveria bassiana</i> GHA	Botanigard
Nematodes	<i>Meloidogyne</i> spp.						Prophyta GmbH	<i>Paecilomyces lilacinus</i> strain 251	BioAct WG		
							Ecospray	Garlic extract	NemGuard		
Cutworms/turnip moth	<i>Agrotis</i> spp.	<i>Bacillus thuringiensis</i> var <i>kurstaki</i>	DiPel DF	Yes			Fargro Ltd., Interfarm (UK) Ltd.	Valent Biosciences Inc.	<i>Bacillus thuringiensis</i> var <i>kurstaki</i>	DiPel DF	Bt Isolate: (ABTS 351, PB 54, SA 11, SA12 and EG 2348)
					<i>Steinernema carpocapsae</i>	Nemasys C	Agrovista	Becker Underwood Ltd,			
					<i>Steinernema carpocapsae</i>	Capsanem	Koppert UK Ltd	Koppert B.V.			

Target Organism Common name	Target organism Scientific name	UK - registered		SOLA	UK non-registered ^		UK Distributor	Manufacturer	EU registered - listed active	EU product	Comments	
		Active	Product		Active	Product						
					<i>Steinernema carpocapsae</i>	Nematop	Fast Products Ltd.	E-Nema GmbH				
Sclerotinia	<i>Sclerotinia sclerotiorum</i>	<i>Coniothyrium minitans</i> CON/M/91-08	Contans WG	No			Fargro Ltd.& Belchim Crop Protection Ltd.	Prophyta GmbH	<i>Coniothyrium minitans</i> CON/M/91-08	Contans WG		
							Fargro Ltd.& Syngenta bioline Ltd.	Agraquest Inc.	<i>Bacillus subtilis</i> QST713	Serenade ASO or Max	UK registration for botrytis only	
								Biopreparaty Co. Ltd	<i>Pythium oligandrum</i> (M1)	Polyversum		
Canker (parsnip) Cavity spot	<i>Phoma</i> sp. <i>Pythium violae</i> & <i>sulcatum</i> <i>Alternaria dauci/A. radicina</i> , <i>Alternaria</i> , <i>Fusarium</i> and <i>Itersonilia</i> <i>Helicobasidium purpureum</i> <i>Mycocentrospora acerina</i> & <i>Fusarium</i> spp. <i>Acrothecium carotae</i>				<i>Trichoderma harzianum</i> Rifai (T-22)	Trianum	Koppert	BioWorks Inc.	<i>Trichoderma harzianum</i> Rifai (T-22)	Root Shield WP or Granules, Trianum		
Blight							Fargro Ltd.& Syngenta bioline Ltd.	Agraquest Inc.	<i>Bacillus subtilis</i> QST713	Serenade ASO or Max	UK registration for botrytis only	
Crown rot								Biopreparaty Co. Ltd	<i>Pythium oligandrum</i> (M1)	Polyversum		
Violet Root Rot								Verdera Oy	<i>Gliocladium catenulatum</i> strain J1446	Gliomix	Seedlings	
Liquorice rot									Verdera Oy	<i>Streptomyces</i> K61 (K61) (formerly <i>Streptomyces griseoviridis</i>)	Mycostop	
									Unknown	<i>Trichoderma aspellerum</i> (ICC012) (T11) (TV1)	unknown	
									unknown	<i>Trichoderma polysporum</i> (IMI 206039)	unknown	
									unknown	<i>Trichoderma atroviride</i> (IMI 206040) (T 11)	unknown	

Target Organism Common name	Target organism Scientific name	UK - registered		SOLA	UK non-registered ^		UK Distributor	Manufacturer	EU registered - listed active	EU product	Comments
		Active	Product		Active	Product					
								unknown	<i>Trichoderma gamsii</i> (ICC080)	unknown	
Powdery mildew	<i>Erysiphe heraclei</i>						Fargro Ltd.& Syngenta bioline Ltd.	Agraquest Inc.	<i>Bacillus subtilis</i> QST713	Serenade ASO or Max	UK registration for botrytis only
								Intrachem Bio	<i>Ampelomyces quisqualis</i> strain AQ10	AQ10	
Common scab	<i>Streptomyces scabies</i>										
Cercospora	<i>Cercospora carotae</i>										

Table 11: Biopesticide Gap Assessment for Herb Crops

Target Organism Common name	Target organism Scientific name	UK - registered		SOLA	UK non-registered ^		UK Distributor	Manufacturer	EU registered - listed active	EU product	Comments
		Active	Product		Active	Product					
Fungus gnat	<i>Lycoriella</i> sp., <i>Bradysia</i> sp.				<i>Steinernema feltiae</i>	Nemasys	Syngenta bioline, BCP, Hutchinsons, Avoncrop, Fargro, UAP, JF McKenna	Becker Underwood Ltd.	N/A		
Lepidoptera - Tortrix, swift moth, cutworms	<i>Toricidae</i> , <i>Hepialus lupulinus</i> , <i>Agrotis</i> spp.	<i>Bacillus thuringiensis var kurstaki</i>	DiPel DF	Yes			Fargro Ltd., Interfarm (UK) ltd.	Valent Biosciences Inc.	<i>Bacillus thuringiensis var kurstaki</i>	DiPel DF	Bt Isolate: (ABTS 351, PB 54, SA 11, SA12 and EG 2348)
					<i>Steinernema carpocapsae</i>	Nemasys C	Agrovista	Becker Underwood Ltd,			
					<i>Steinernema carpocapsae</i>	Capsanem	Koppert Uk Ltd	Koppert B.V.			
					<i>Steinernema carpocapsae</i>	Nematop	Fast Products Ltd.	E-Nema GmbH			
Aphids		<i>Lecanicillium muscarium</i> (formerly <i>Verticillium lecanii</i>)	Vertalec	Yes			Fargro Ltd.	Koppert B.V.	<i>Lecanicillium muscarium</i> (formerly <i>Verticillium lecanii</i>)	Vertalec	In UK for protected crops only
				N/A	Maltodextrin	Majestik	Certis Europe BV	Certis LLC	Maltodextrin - pending	Pending	
								Thermo trilogy	<i>Paecilomyces fumosoroseus</i> (Apopka strain 97, PFR 97 or CG 170, ATCC20874)	unknown	Unknown if still in production as Thermotriology no longer in business
								Novozymes Biologicals Inc.	<i>Metarhizium anisopliae</i> (F52)	Bio1020, Met52,	
								Agrifutur s.r.l	<i>Metarhizium anisopliae</i> (BIPESCO 5)	GranMet WP,	

Target Organism Common name	Target organism Scientific name	UK - registered		SOLA	UK non-registered ^		UK Distributor	Manufacturer	EU registered - listed active	EU product	Comments	
		Active	Product		Active	Product						
								Intrachem Bio srl	<i>Beauveria bassiana</i> ATC74040	Naturalis-L	UK registered for whitefly and thrips	
								Bioworks Inc.	<i>Beauveria bassiana</i> GHA	Botanigard		
Thrips	<i>Thrips</i> spp.	<i>Beauveria bassiana</i> ATC74040	Naturalis-L	No			Belchim Crop Protection Limited	Intrachem Bio srl	<i>Beauveria bassiana</i> ATC74040	Naturalis-L	UK registered for whitefly and thrips	
		<i>Lecanicillium muscarium</i> (formerly <i>Verticillium lecanii</i>)	Mycotal	Yes			Fargro Ltd.	Koppert B.V.	<i>Lecanicillium muscarium</i> (formerly <i>Verticillium lecanii</i>)	Mycotal		
								Bioworks Inc.	<i>Beauveria bassiana</i> GHA	Botanigard		
									Novozymes Biologicals Inc.	<i>Metarhizium anisopliae</i> (F52)	Bio1020, Met52,	
									Agrifutur s.r.l	<i>Metarhizium anisopliae</i> (BIPESCO 5)	GranMet WP,	
							<i>Steinernema feltiae</i>	Nemasys F	Syngenta bioline, BCP, Hutchinsons, Avoncrop, Fargro, UAP, JF McKenna, Sylvan	Becker Underwood Ltd.	N/A	
Wireworms	<i>Agriotes</i> sp.				<i>Steinernema feltiae</i>	Nemasys	Becker Underwood ltd,	Becker Underwood Ltd.	N/A			
								Novozymes Biologicals Inc.	<i>Metarhizium anisopliae</i> (F52)	Bio1020, Met52,		
Vine weevils	<i>Otiorhynchus sulcatus</i>				<i>Steinernema kraussei</i>	Nemasys L	Syngenta bioline, BCP, Hutchinsons, Avoncrop, Fargro, UAP, JF McKenna	Becker Underwood Ltd.	N/A			

Target Organism Common name	Target organism Scientific name	UK - registered		SOLA	UK non-registered ^		UK Distributor	Manufacturer	EU registered - listed active	EU product	Comments
		Active	Product		Active	Product					
					<i>Heterorhabditis megidis</i>	Nemasys H	Syngenta bioline, BCP, Hutchinsons, Avoncrop, Fargro, UAP, JF McKenna	Becker Underwood Ltd.	N/A		
					<i>Heterorhabditis megidis</i>	Lavanem	Koppert UK Ltd	Koppert B.V.			
					<i>Heterorhabditis bacteriophora</i>			E-Nema GmbH	N/A		
								Novozymes Biologicals Inc.	<i>Metarhizium anisopliae</i> (F52)	Bio1020, Met52,	Submitted for UK registration, marketing 2010
Whitefly	<i>Trialeurodes vaporarum</i>	<i>Lecanicillium muscarium</i> (formerly <i>Verticillium lecanii</i>)	Mycotal	Yes			Koppert B.V., Fargro Ltd.	Koppert B.V.	<i>Lecanicillium muscarium</i> (formerly <i>Verticillium lecanii</i>)	Mycotal	
		Fatty acids	Savona				Koppert B.V.	Koppert B.V.	Fatty acids	Savona	
		<i>Beauveria bassiana</i> ATC74040	Naturalis-L	No			Belchim Crop Protection Limited	Intrachem Bio	<i>Beauveria bassiana</i> ATC74040	Naturalis-L	
								Futureco Biosciences	<i>Beauveria bassiana</i> GHA	Botanigard	Mycotal - protected crops only
								Novozymes Biologicals Inc.	<i>Metarhizium anisopliae</i> (F52)	Bio1020, Met52,	
								Agrifutur s.r.l	<i>Metarhizium anisopliae</i> (BIPESCO 5)	GranMet WP,	
								Futureco S.L.	<i>Paecilomyces fumosoroseus</i> strain Fe9901 pending	Nofly	
Carrot fly	<i>Psila rosae</i>										
Flea beetles											

Target Organism Common name	Target organism Scientific name	UK - registered		SOLA	UK non-registered ^		UK Distributor	Manufacturer	EU registered - listed active	EU product	Comments
		Active	Product		Active	Product					
Sciarid fly	<i>Lyriomyza sp.</i> <i>Bryoniae sp.</i>				<i>Steinernema feltiae</i>	Nemasys	Becker Underwood ltd, Fargro ltd	Becker Underwood Ltd.	N/A		
Leather jackets	<i>Tipula spp.</i>				<i>Steinernema feltiae</i>	Nemasys	Becker Underwood ltd, Fargro ltd	Becker Underwood Ltd.	N/A		
Slugs	<i>Deroceras Spp.</i>				<i>Phasmarhabditis hermaphrodita</i>	Nemaslug	Fargro Ltd., Becker Underwood Ltd.	Becker Underwood Ltd.	N/A		

Damping off, Root and stem diseases, wilt, leaf spot, bacteria crown and leaf rots, Alternaria	<i>Pythium</i> , <i>Phytophthora</i> , <i>Rhizoctonia spp.</i> , <i>Fusarium</i> and <i>Verticillium spp.</i> , <i>Verticillium sp.</i> , <i>Septoria sp.</i> , <i>Ramularia sp.</i>				<i>Trichoderma harzianum</i> Rifai (T-22)	Trianum	Koppert	BioWorks Inc.	<i>Trichoderma harzianum</i> Rifai (T-22)	Root Shield WP or Granules, Trianum		
							Fargro Ltd.& Syngenta bioline Ltd.	Agraquest Inc.	<i>Bacillus subtilis</i> QST713	Serenade ASO or Max	UK registration for botrytis only	
									Biopreparaty Co. Ltd	<i>Pythium oligandrum</i> (M1)	Polyversum	
									Verdera Oy	<i>Gliocladium catenulatum</i> strain J1446	Gliomix	Seedlings
									Verdera Oy	<i>Streptomyces</i> K61 (K61) (formerly <i>streptomyces griseoviridis</i>)	Mycostop	
									Unknown	<i>Trichoderma aspellerum</i> (ICC012) (T11) (TV1)	unknown	
									unknown	<i>Trichoderma polysporum</i> (IMI 206039)	unknown	
									unknown	<i>Trichoderma atroviride</i> (IMI 206040) (T 11)	unknown	

Target Organism Common name	Target organism Scientific name	UK - registered		SOLA	UK non-registered ^		UK Distributor	Manufacturer	EU registered - listed active	EU product	Comments
		Active	Product		Active	Product					
								unknown	<i>Trichoderma gamsii</i> (ICC080)	unknown	
Botrytis	<i>Botrytis cinerea</i>	<i>Bacillus subtilis</i> QST713	Serenade ASO	Yes			Fargro Ltd.& Syngenta bioline Ltd.	Agraquest Inc.	<i>Bacillus subtilis</i> QST713	Serenade ASO	
Downy mildew	<i>Peronospora</i> spp.										
Powdery mildew	<i>Erysiphe</i> spp. and <i>Oidium</i> spp.						Fargro Ltd.& Syngenta bioline Ltd.	Agraquest Inc.	<i>Bacillus subtilis</i> QST713	Serenade ASO or Max	UK registration for botrytis only
								Intrachem Bio	<i>Ampelomyces quisqualis</i> strain AQ10	AQ10	
Rust	<i>Puccinia</i> spp.										
White rot	<i>Sclerotium cepivorum</i>	<i>Coniothyrium minitans</i> CON/M/91-08	Contans WG	No			Fargro Ltd.& Belchim Crop Protection Ltd.	Prophyta GmbH	<i>Coniothyrium minitans</i> CON/M/91-08	Contans WG	
							Fargro Ltd.& Syngenta bioline Ltd.	Agraquest Inc.	<i>Bacillus subtilis</i> QST713	Serenade ASO or Max	UK registration for botrytis only
								Biopreparaty Co. Ltd	<i>Pythium oligandrum</i> (M1)	Polyversum	

Table 12: Biopesticide Gap Assessment for Leafy salad Crops

Target Organism Common name	Target organism Scientific name	UK - registered		SOLA	UK non-registered ^		UK Distributor	Manufacturer	EU registered - listed active	EU product	Comments
		Active	Product		Active	Product					
Caterpillars, Tortrix Silver Y caterpillars angel-shades moth Tomato moth	<i>Agrotis</i> spp.	<i>Bacillus thuringiensis</i> var <i>kurstaki</i>	DiPel DF	Yes			Fargro Ltd., Interfarm (UK) Ltd.	Valent Biosciences Inc.	<i>Bacillus thuringiensis</i> var <i>kurstaki</i>	DiPel DF	Bt Isolate: (ABTS 351, PB 54, SA 11, SA12 and EG 2348)
	<i>Autographa gamma</i>						Agrovista	Becker Underwood Ltd,			
	<i>Phlogophora meticulosa</i>						Koppert Uk Ltd	Koppert B.V.			
	<i>Lacanobia oleracea</i>						Fast Products Ltd.	E-Nema GmbH			
Lettuce aphid, Peach-potato aphid, Black bean aphid, Lettuce root aphid Lettuce currant aphid Glasshouse potato aphid Shallot aphid Potato aphid Chrysanthemum leaf aphid	<i>Nasanovia ribisnigri</i>	<i>Lecanicillium muscarium</i> (formerly <i>Verticillium lecanii</i>)	Vertalec	Yes			Fargro Ltd.	Koppert B.V.	<i>Lecanicillium muscarium</i> (formerly <i>Verticillium lecanii</i>)	Vertalec	In UK for protected crops only
	<i>Myzus persicae</i>			N/A	Maltodextrin	Majestik	Certis Europe BV	Certis LLC	Maltodextrin - pending	Pending	
	<i>Aphis fabae</i>							Thermo trilogy	<i>Paecilomyces fumosoroseus</i> (Apopka strain 97, PFR 97 or CG 170, ATCC20874)	unknown	Unknown if still in production as Thermotriology no longer in business
	<i>Pemphigus bursarius</i>							Novozymes Biologicals Inc.	<i>Metarhizium anisopliae</i> (F52)	Bio1020, Met52,	
	<i>Nasonovia ribisnigri</i>							AgriFuture s.r.l	<i>Metarhizium anisopliae</i> (BIPESCO 5)	GranMet WP,	
	<i>Aulacorthum solani</i>							Intrachem Bio srl	<i>Beauveria bassiana</i> ATC74040	Naturalis-L	UK registered for whitefly and thrips
	<i>Myzus ascalonicus</i>							Bioworks Inc.	<i>Beauveria bassiana</i> GHA	Botanigard	
	<i>Macrosiphum euphorbiae</i> <i>Phytomyza syngenesia</i>										
Bean seed fly	<i>Delia platura</i>										
Shore fly											

Target Organism Common name	Target organism Scientific name	UK - registered		SOLA	UK non-registered ^		UK Distributor	Manufacturer	EU registered - listed active	EU product	Comments
		Active	Product		Active	Product					
Leatherjackets	<i>Tipula</i> spp.				<i>Steinernema feltiae</i>	Nemasys	Becker Underwood ltd,	Becker Underwood Ltd.	N/A		
Wireworms	<i>Agriotes</i> spp.				<i>Steinernema feltiae</i>	Nemasys	Becker Underwood ltd	Becker Underwood Ltd.	N/A		
								Novozymes Biologicals Inc.	<i>Metarhizium anisopliae</i> (F52)	Bio1020, Met52,	
Glasshouse whitefly	<i>Trialeurodes vaporarum</i>	<i>Lecanicillium muscarium</i> (formerly <i>Verticillium lecanii</i>)	Mycotal	Yes			Koppert B.V., Fargo Ltd.	Koppert B.V.	<i>Lecanicillium muscarium</i> (formerly <i>Verticillium lecanii</i>)	Mycotal	
		Fatty acids	Savona				Koppert B.V.	Koppert B.V.	Fatty acids	Savona	
		<i>Beauveria bassiana</i> ATC74040	Naturalis-L	No			Belchim Crop Protection Limited	Intrachem Bio	<i>Beauveria bassiana</i> ATC74040	Naturalis-L	
								Futureco Biosciences	<i>Beauveria bassiana</i> GHA	Botanigard	Mycotal - protected crops only
								Novozymes Biologicals Inc.	<i>Metarhizium anisopliae</i> (F52)	Bio1020, Met52,	
								Agrifutur s.r.l	<i>Metarhizium anisopliae</i> (BIPESCO 5)	GranMet WP,	
								Futureco S.L.	<i>Paecilomyces fumosoroseus</i> strain Fe9901 pending	Nofly	
Leaf miners	<i>Lyriomyza</i> sp., <i>Pegomya hyoscyami</i>				<i>Steinernema feltiae</i>	Nemasys	Syngenta bioline, BCP, Hutchinsons, Avoncrop, Fargo, UAP, JF McKenna, Sylvan	Becker Underwood Ltd.	N/A		
Thrips	<i>Thrips</i> spp., <i>Frankliniella occidentalis</i>	<i>Beauveria bassiana</i> ATC74040	Naturalis-L	No			Belchim Crop Protection Limited	Intrachem Bio srl	<i>Beauveria bassiana</i> ATC74040	Naturalis-L	UK registered for whitefly and thrips

Target Organism Common name	Target organism Scientific name	UK - registered		SOLA	UK non-registered ^		UK Distributor	Manufacturer	EU registered - listed active	EU product	Comments
		Active	Product		Active	Product					
		<i>Lecanicillium muscarium</i> (formerly <i>Verticillium lecanii</i>)	Mycotal	Yes			Fargro Ltd.	Koppert B.V.	<i>Lecanicillium muscarium</i> (formerly <i>Verticillium lecanii</i>)	Mycotal	
								Bioworks Inc.	<i>Beauveria bassiana</i> GHA	Botanigard	
								Novozymes Biologicals Inc.	<i>Metarhizium anisopliae</i> (F52)	Bio1020, Met52,	
								Agrifutur s.r.l	<i>Metarhizium anisopliae</i> (BIPESCO 5)	GranMet WP,	
					<i>Steinernema feltiae</i>	Nemasys F	Syngenta bioline, BCP, Hutchinsons, Avoncrop, Fargro, UAP, JF McKenna, Sylvan	Becker Underwood Ltd.	N/A		
Slugs					<i>Phasmarhabditis hermaphrodita</i>	Nemaslug	Syngenta bioline, BCP, Hutchinsons, Avoncrop, Fargro, UAP, JF McKenna, Branstons, Procam, Wallace of Kelso	Becker Underwood Ltd.	N/A		
Sclerotinia	<i>Sclerotinia sclerotiorum</i> , <i>S. minor</i>	<i>Coniothyrium minitans</i> CON/M/91-08	Contans WG	No			Fargro Ltd.& Belchim Crop Protection Ltd.	Prophyta GmbH	<i>Coniothyrium minitans</i> CON/M/91-08	Contans WG	
							Fargro Ltd.& Syngenta bioline Ltd.	Agraquest Inc.	<i>Bacillus subtilis</i> QST713	Serenade ASO or Max	UK registration for botrytis only

Target Organism Common name	Target organism Scientific name	UK - registered		SOLA	UK non-registered ^		UK Distributor	Manufacturer	EU registered - listed active	EU product	Comments	
		Active	Product		Active	Product						
								Biopreparaty Co. Ltd	<i>Pythium oligandrum</i> (M1)	Polyversum		
Botrytis	<i>Botrytis cinerea</i>	<i>Bacillus subtilis</i> QST713	Serenade ASO	Yes			Fargro Ltd.& Syngenta bioline Ltd.	Agraquest Inc.	<i>Bacillus subtilis</i> QST713	Serenade ASO		
Downy mildew	<i>Bremia lactucae</i>											
Powdery mildew	<i>Erysiphe</i> spp.						Fargro Ltd.& Syngenta bioline Ltd.	Agraquest Inc.	<i>Bacillus subtilis</i> QST713	Serenade ASO or Max	UK registration for botrytis only	
								Intrachem Bio	<i>Ampelomyces quisqualis</i> strain AQ10	AQ10		
Damping off	<i>Peronospora</i> spp., <i>Bremia lactucae</i> <i>Pythium</i> and <i>Rhizoctonia solani</i> , <i>Colletotrichum</i> (Anthracnose) <i>Erwinia</i> spp. , <i>Microdochium panattonianum</i>				<i>Trichoderma harzianum</i> Rifai (T-22)	Triatum	Koppert	BioWorks Inc.	<i>Trichoderma harzianum</i> Rifai (T-22)	Root Shield WP or Granules, Triatum		
Leaf spots							Fargro Ltd.& Syngenta bioline Ltd.	Agraquest Inc.	<i>Bacillus subtilis</i> QST713	Serenade ASO or Max	UK registration for botrytis only	
Butt rot Ring spot									Biopreparaty Co. Ltd	<i>Pythium oligandrum</i> (M1)	Polyversum	
									Verdera Oy	<i>Gliocladium catenulatum</i> strain J1446	Gliomix	Seedlings
									Verdera Oy	<i>Streptomyces</i> K61 (K61) (formerly <i>Streptomyces griseoviridis</i>)	Mycostop	
									Unknown	<i>Trichoderma aspellerum</i> (ICC012) (T11) (TV1)	unknown	
									unknown	<i>Trichoderma polysporum</i> (IMI 206039)	unknown	

Target Organism Common name	Target organism Scientific name	UK - registered		SOLA	UK non-registered ^		UK Distributor	Manufacturer	EU registered - listed active	EU product	Comments
		Active	Product		Active	Product					
								unknown	<i>Trichoderma atroviride</i> (IMI 206040) (T 11)	unknown	
								unknown	<i>Trichoderma gamsii</i> (ICC080)	unknown	
LMV	<i>Lettuce mosaic virus</i>										
CMV	cucumber mosaic virus										
BWYV	<i>Beet western yellow virus</i>										
Big vein	<i>Olpidium brassicae</i>										

Table 13: Biopesticide Gap Assessment for Onion Crops

Target Organism Common name	Target organism Scientific name	UK - registered		SOLA	UK non-registered ^		UK Distributor	Manufacturer	EU registered - listed active	EU product	Comments
		Active	Product		Active	Product					
Onion thrips	<i>Thrips tabaci</i>										
Onion fly	<i>Delia antiqua</i>										
Bean seed fly	<i>Delia platura/lorilega</i>										
Cutworms	<i>Agrotis</i> spp.	<i>Bacillus thuringiensis</i> var <i>kurstaki</i>	DiPel DF	Yes			Fargro Ltd., Interfarm (UK) Ltd.	Valent Biosciences Inc.	<i>Bacillus thuringiensis</i> var <i>kurstaki</i>	DiPel DF	Bt Isolate: (ABTS 351, PB 54, SA 11, SA12 and EG 2348)
					<i>Steinernema carpocapsae</i>	Nemasys C	Agrovista	Becker Underwood Ltd,			
					<i>Steinernema carpocapsae</i>	Capsanem	Koppert Uk Ltd	Koppert B.V.			
					<i>Steinernema carpocapsae</i>	Nematop	Fast Products Ltd.	E-Nema GmbH			
Nematodes	<i>Ditylenchus dipsaci</i>						Prophyta GmbH	<i>Paecilomyces lilacinus</i> strain 251	BioAct WG		
Leaf rot, collar rot, White rot, white tip, leaf blotch Fusarium base rot, neck rot, black rot	<i>Botrytis squamosa</i> <i>Peronospora destructor</i> <i>Sclerotium cepivorum</i> <i>Phytophthora porri</i> <i>Cladosporium allii-cepae</i> <i>Fusarium oxysporum f.sp. cepae</i> <i>Botrytis allii</i> <i>Aspergillus niger</i>				Trichoderma harzianum Rifai (T-22)	Trianium	Koppert	BioWorks Inc.	Trichoderma harzianum Rifai (T-22)	Root Shield WP or Granules, Trianium	
							Fargro Ltd.& Syngenta bioline Ltd.	Agraquest Inc.	<i>Bacillus subtilis</i> QST713	Serenade ASO or Max	UK registration for botrytis only
								Biopreparaty Co. Ltd	<i>Pythium oligandrum</i> (M1)	Polyversum	
								Verdera Oy	<i>Gliocladium catenulatum</i> strain J1446	Gliomix	Seedlings
								Verdera Oy	<i>Streptomyces</i> K61 (K61) (formerly <i>streptomyces griseoviridis</i>)	Mycostop	

Target Organism Common name	Target organism Scientific name	UK - registered		SOLA	UK non-registered ^		UK Distributor	Manufacturer	EU registered - listed active	EU product	Comments
		Active	Product		Active	Product					
								Unknown	<i>Trichoderma aspellerum</i> (ICC012) (T11) (TV1)	unknown	
								unknown	<i>Trichoderma polysporum</i> (IMI 206039)	unknown	
								unknown	<i>Trichoderma atroviride</i> (IMI 206040) (T 11)	unknown	
								unknown	<i>Trichoderma gamsii</i> (ICC080)	unknown	
Botrytis	<i>Botrytis cinerea</i>	<i>Bacillus subtilis</i> QST713	Serenade ASO	Yes			Fargro Ltd.& Syngenta bioline Ltd.	Agraquest Inc.	<i>Bacillus subtilis</i> QST713	Serenade ASO	
Downy mildew											
Blue mould	<i>Penicillium</i> spp.										
Bacteria rots	<i>Pseudomonas gladioli</i> pv. <i>allicola</i> , <i>Erwinia</i> spp., <i>Lactobaccillus</i> spp.										

Table 14: Biopesticide Gap Assessment for Pea & Bean Crops

Target Organism Common name	Target organism Scientific name	UK - registered		SOLA	UK non-registered ^		UK Distributor	Manufacturer	EU registered - listed active	EU product	Comments
		Active	Product		Active	Product					
Field thrips	<i>Thrips angusticeps</i>										
Pea weevil	<i>Sitona lineatus</i>										
Pea aphid, Black bean aphid	<i>Acyrtosiphon pisum</i> <i>Aphis fabae</i>	<i>Lecanicillium muscarium</i> (formerly <i>Verticillium lecanii</i>)	Vertalec	Yes			Fargro Ltd.	Koppert B.V.	<i>Lecanicillium muscarium</i> (formerly <i>Verticillium lecanii</i>)	Vertalec	In UK for protected crops only
				N/A	Maltodextrin	Majestik	Certis Europe BV	Certis LLC	Maltodextrin - pending	Pending	
								Thermo trilogy	<i>Paecilomyces fumosoroseus</i> (<i>Apopka strain 97, PFR 97 or CG 170, ATCC20874</i>)	unknown	Unknown if still in production as Thermotrilogy no longer in business
								Novozymes Biologicals Inc.	<i>Metarhizium anisopliae</i> (F52)	Bio1020, Met52,	
								Agrifutur s.r.l	<i>Metarhizium anisopliae</i> (BIPESCO 5)	GranMet WP,	
								Intrachem Bio srl	<i>Beauveria bassiana</i> ATC74040	Naturalis-L	UK registered for whitefly and thrips
								Bioworks Inc.	<i>Beauveria bassiana</i> GHA	Botanigard	
Pea moth	<i>Cydia nigricana</i>										
Silver Y moth	<i>Autographa gamma</i>	<i>Bacillus thuringiensis</i> var <i>kurstaki</i>	DiPel DF	Yes			Fargro Ltd., Interfam (UK) Ltd.	Valent Biosciences Inc.	<i>Bacillus thuringiensis</i> var <i>kurstaki</i>	DiPel DF	Bt Isolate: (ABTS 351, PB 54, SA 11, SA12 and EG 2348)
Pea midge	<i>Contarinia pisi</i>										
Bean seed beetle	<i>Bruchus rufimanus</i>										

Target Organism Common name	Target organism Scientific name	UK - registered		SOLA	UK non-registered ^		UK Distributor	Manufacturer	EU registered - listed active	EU product	Comments
		Active	Product		Active	Product					
Slugs					<i>Phasmarhabditis hermaphrodita</i>	Nemaslug	Syngenta bioline, BCP, Hutchinsons, Avoncrop, Fargro, UAP, JF McKenna, Branstons, Procam, Wallace of Kelso	Becker Underwood Ltd.	N/A		
Pea cyst nematode	<i>Heterodera göttingiana</i>										
Stem nematode	<i>Ditylenchus dipsaci</i>							Prophyta GmbH	<i>Paecilomyces lilacinus</i> strain 251	BioAct WG	

Damping off, Foot and root rot, black root rot, Leaf and pod spot	<i>Pythium spp</i> <i>Fusarium solani f. sp. pisi</i> , <i>Phoma medicaginis var. pinodella/Aphanomyces euteiches</i> , <i>Fusarium oxysporum f. sp. pisi</i> / <i>Fusarium culmorum</i> , <i>Thielaviopsis basicola</i> <i>Ascochyta spp.</i> , <i>Mycosphaerella pinodes</i> , <i>Phoma medicaginis var pinodella</i>				<i>Trichoderma harzianum</i> Rifai (T-22)	Triatum	Koppert	BioWorks Inc.	<i>Trichoderma harzianum</i> Rifai (T-22)	Root Shield WP or Granules, Triatum		
							Fargro Ltd.& Syngenta bioline Ltd.	Agraquest Inc.	<i>Bacillus subtilis</i> QST713	Serenade ASO or Max	UK registration for botrytis only	
									Biopreparaty Co. Ltd	<i>Pythium oligandrum</i> (M1)	Polyversum	
									Verdera Oy	<i>Gliocladium catenulatum</i> strain J1446	Gliomix	Seedlings
									Verdera Oy	<i>Streptomyces</i> K61 (K61) (formerly <i>streptomyces griseoviridis</i>)	Mycostop	
									Unknown	<i>Trichoderma aspellerum</i> (ICC012) (T11) (TV1)	unknown	

Target Organism Common name	Target organism Scientific name	UK - registered		SOLA	UK non-registered ^		UK Distributor	Manufacturer	EU registered - listed active	EU product	Comments
		Active	Product		Active	Product					
								unknown	<i>Trichoderma polysporum</i> (IMI 206039)	unknown	
								unknown	<i>Trichoderma atroviride</i> (IMI 206040) (T 11)	unknown	
								unknown	<i>Trichoderma gamsii</i> (ICC080)	unknown	
Downy mildew	<i>Peronospora viciae</i>										
Powdery mildew	<i>Erysiphe pisi</i>						Fargro Ltd.& Syngenta bioline Ltd.	Agraquest Inc.	<i>Bacillus subtilis</i> QST713	Serenade ASO or Max	UK registration for botrytis only
								Intrachem Bio	<i>Ampelomyces quisqualis</i> strain AQ10	AQ10	
Botrytis pod rot/chocolate spot	<i>Botrytis cinerea/Botrytis fabae</i>	<i>Bacillus subtilis</i> QST713	Serenade ASO	Yes			Fargro Ltd.& Syngenta bioline Ltd.	Agraquest Inc.	<i>Bacillus subtilis</i> QST713	Serenade ASO	
Sclerotinia	<i>Sclerotinia sclerotiorum</i>	<i>Coniothyrium minitans</i> CON/M/91-08	Contans WG	No			Fargro Ltd.& Belchim Crop Protection Ltd.	Prophyta GmbH	<i>Coniothyrium minitans</i> CON/M/91-08	Contans WG	
							Fargro Ltd.& Syngenta bioline Ltd.	Agraquest Inc.	<i>Bacillus subtilis</i> QST713	Serenade ASO or Max	UK registration for botrytis only
								Biopreparaty Co. Ltd	<i>Pythium oligandrum</i> (M1)	Polyversum	
Pea enation mosaic virus	PEMV										
Bean leaf roll virus	BLRV										
Broad Bean stain virus	BBSV										

Target Organism Common name	Target organism Scientific name	UK - registered		SOLA	UK non-registered ^		UK Distributor	Manufacturer	EU registered - listed active	EU product	Comments
		Active	Product		Active	Product					
Bean common mosaic virus	BCMV										
Bean yellow mosaic virus	BYMV										
Pea bacterial blight	<i>Pseudomonas syringae pv pisi</i>										
Halo blight	<i>Pseudomonas syringae pv phaseolicola</i>										
Rust	<i>Uromyces fabae/Uromyces appendiculatus</i>										

Figure 1 - Overview of the EU Regulatory Process for a New Active Substance

(From: Microbial biopesticides in the European Union with specific reference to the UK. R L Gwynn and J Dale. February 2009)



