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Research Institute of Organic Agriculture
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WASTEREUSE

Towards a Sustainable Use of Agricultural Waste

12 May 2015, Brussels, European Economic and Social Committee

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Insect-technology:
A new approach to use organic waste in agriculture and it's relation to the development of the organic market.

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Contents of the presentation

- The IFOAM EU Group
- Introduction to Organic Farming
- Insect Technology
- Research & Application
- Conclusion: Expectations for the Organic market

The IFOAM EU Group

- The EU Group of the International Federation of Organic Agriculture Movements is the European umbrella organisation for organic food and farming

- Is engaged for the adoption of ecologically, socially and economically sound agriculture systems based on the principles of organic agriculture – health, ecology, fairness and care

- More than 170 member organisations

- Work spans the entire organic food chain and beyond: from farmers and processors, retailers, certifiers, consultants, traders and researchers to environmental- and consumer advocacy bodies

Source: IFOAM

What is Organic Farming?

- **Organic Agriculture (OA) is an alternative to conventional and industrial agriculture, legally defined by Regulation (EC) No 834/2007, complemented by private standards.**

- **OA is based on a systemic approach, considers the interaction between the plants and their environments,**

- **OA is a driver for agronomic innovation.**

Source: IFOAM

What is Organic Farming?

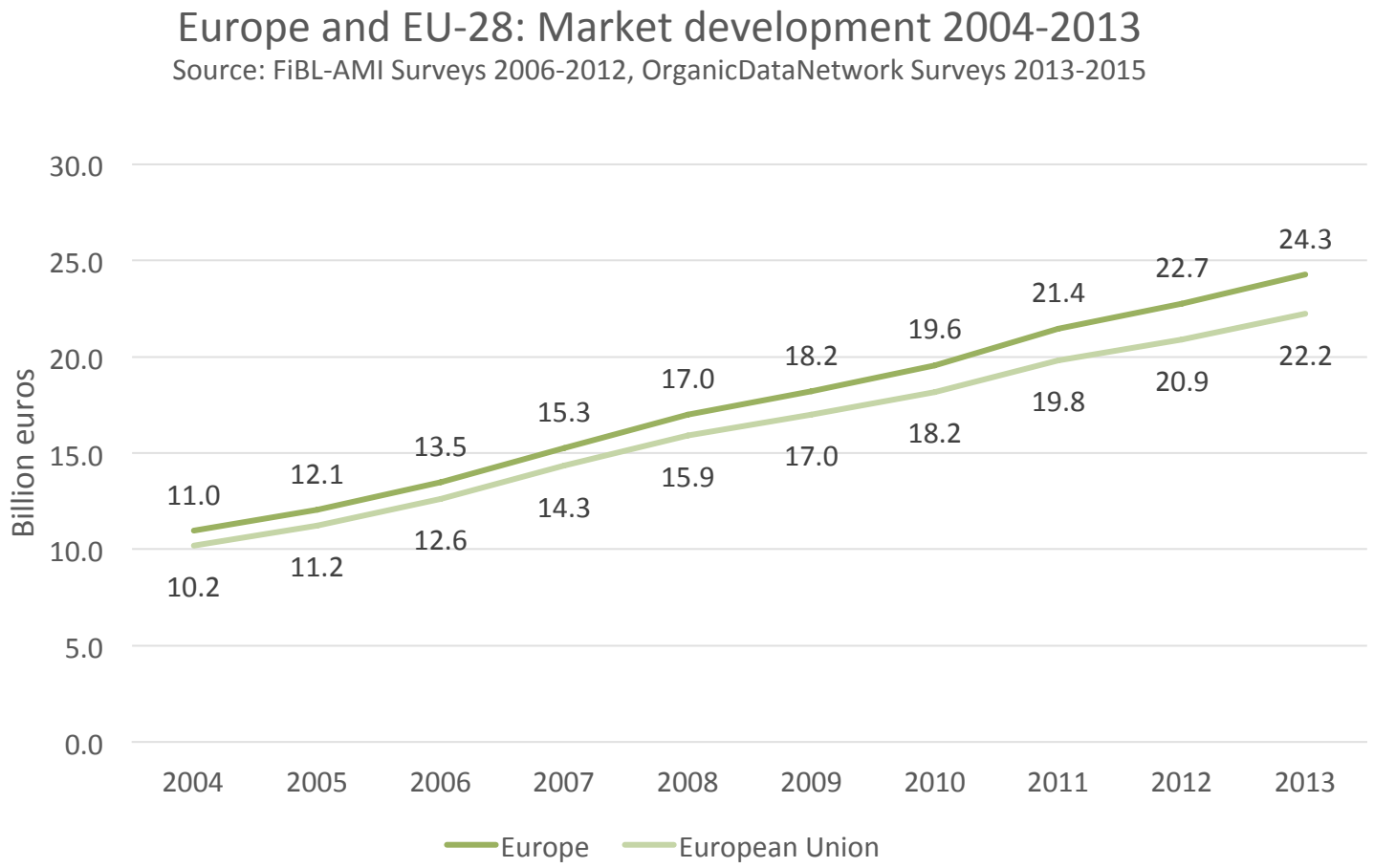
- **OA forbids the use of GMOs and pesticides.**

- **OA is a production system that sustain health of soils, eco-systems and people. It relies on ecological processes, biodiversity and cycles adapted to local conditions, rather than the use of inputs with adverse effects.**

- **OA combines tradition, innovation and science to benefit the shared environment and promote fair relationships and a good quality of life for all involved**

Source: IFOAM

A growing market
Organic Market Trends 2004-2013



IFOAM EU GROUP MAKING EUROPE MORE ORGANIC

Organic agriculture and utilisation of agricultural waste

- Organic agriculture is a systemic approach that can tackle the issue of agricultural waste, which should not be discarded. The focus should be on the ways that they can be utilised in order to close the nutrient cycles and benefit the farm's economy.

- Such ways are
  - Biogas production
  - On-farm use as fertilizer
  - Insect technology – that will be presented here

Source: IFOAM

Insect Technology

- *Hermetia illucens*; Black Soldier Fly
- Global abundance: Tropics, Sub-tropics, Mediterranean, Temperate Europe
- Larvae could use nearly all organic substrate for growth
- Last larval stadium (pre-pupa) contains 45% protein; 35 % fat
- Meal can be purified to ≥ 60% protein, < 10% fat
- Favourable amino-acid profile (similar to fish meal)

Source: FiBL

Legal situation I

- The legislative situation in the EU is slowing down the fast industrial development of insect production at present.
- Insects must be processed in accordance with the EU Animal By-Products Regulation (EC) 1069/2009 to become processed animal protein (PAP) before they can be fed to livestock.
- Under this regulation, non-pathogenic insects are classified as category 3 material (low risk material) and would therefore be suitable for feeding to farmed animals.
- However, the TSE regulation (EC) 999/2001 bans all PAP except fishmeal from being used in animal feeds, if they are not transformed to hydrolysed proteins.
- Insect larvae are considered as livestock and are therefore not allowed to be fed with non-hydrolysed C3-material and any kind of animal manure

Quelle: Koelemann, E., 2014

Legal situation II

- The TSE regulation is based on processing raw materials in certified slaughterhouses – as insects do not follow the same route as livestock when it comes to slaughtering insect PAP can therefore not meet the requirements of the TSE regulation.

- Producers of insect meal have to work according to the General Food Law Regulation (EC 178/2002) as well as the regulations on food (EC 854/2004) and feed hygiene (EC 183/2005). These regulations require production sites to be registered and approved following an on-site visit including evaluation of HACCP procedures.

- If insects are to be used for feed, maximum permitted levels of contaminants (e.g. heavy metals) are defined by directive (EC) 2002/32 on Undesirable Substances in Animal Feed.

Insect Technology

Focus: BSF

Source: Internet

Insect Technology

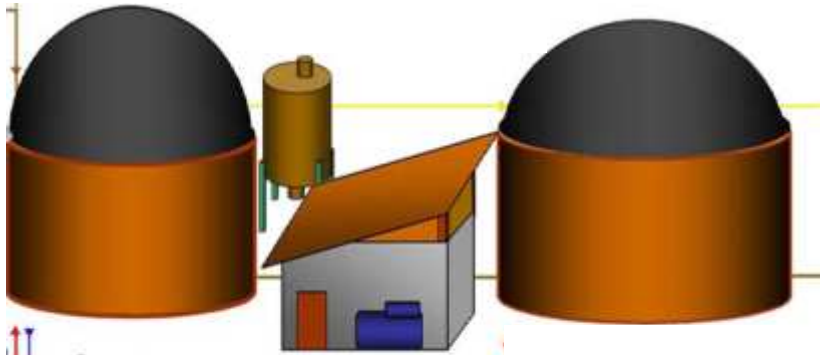
Input

Farm- and
Food waste

Output

Feed Proteins, Oils

Output



Biogas

Output

Residues

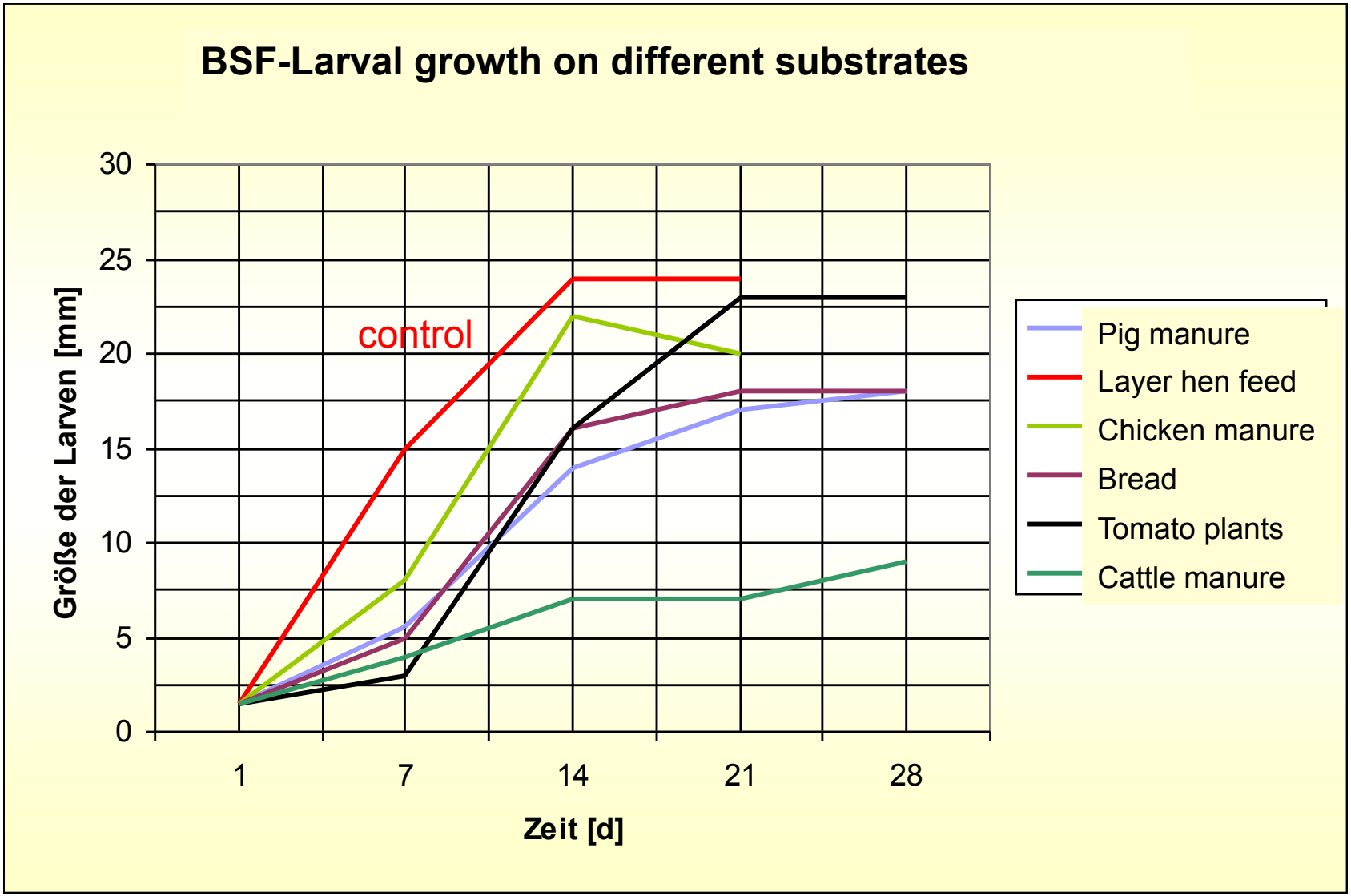
Fertilizer

Source: Anonymus, Internet

Insect Technology

- 90 million tons of food are discarded annually in the EU (agriculture and fishery excluded)
- Disposal and further use is mainly done by composting, biogas production, burning or landfilling
- Raising competition between formulated feeds and food:
  - 20 million tons of small fish are processed to fish meal (4.5 million t, from which 90% are fed to fish again)
- Insect technology can use food waste as well as agricultural waste and transform it to feed proteins, fat and fertilizer or bio-gas

Research and application: Substrates



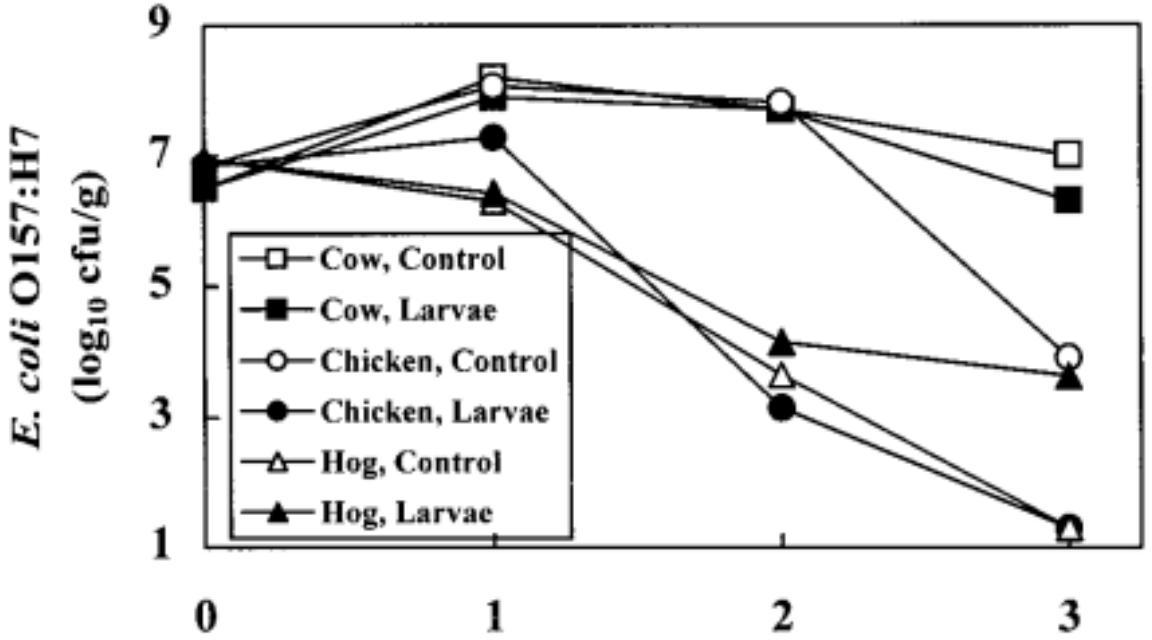
Source: Stamer 2008

Research and application: Organic Waste reduction

Species	Feed source	Total amount of feed	Residue	Waste reduction	Yield		FCR	Source
H. illucens	MOW	151 kg DW	48 kg DW	68% DW	17.8 DW	kg	14.5	**(Diener, 2010)**
H. illucens	Pig manure	68 kg DW	42 kg DW	~39% DW	~2.7 DW	kg	9.6	(Newton et al., 2005a)
H. illucens	Chicken manure	5,240 kg WW	~2,620 WW	~50% WW	196 WW	kg	13.4	(Sheppard et al., 1994)
M. domestica	Chicken and cow manure	125 kg WW	95 kg WW	25% WW	3 kg WW		10.0	(Morgan & Eby, 1975)

Table 4-5: Biomass yield and waste reduction of different pilot-scale systems. MOW = Municipal organic waste; DW = dry weight; WW = wet weight; FCR = Feed conversion ratio

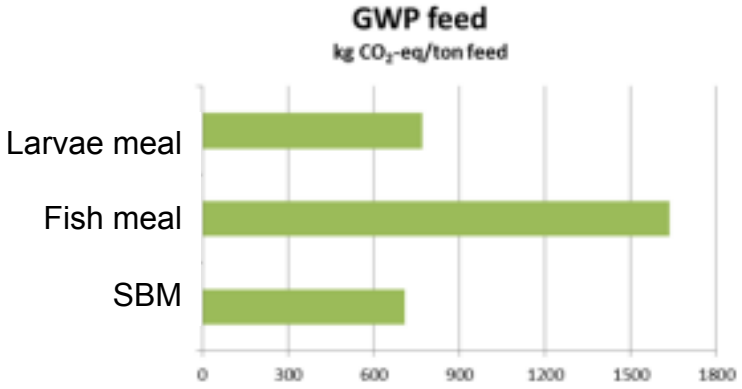
Research and application: Hygiene



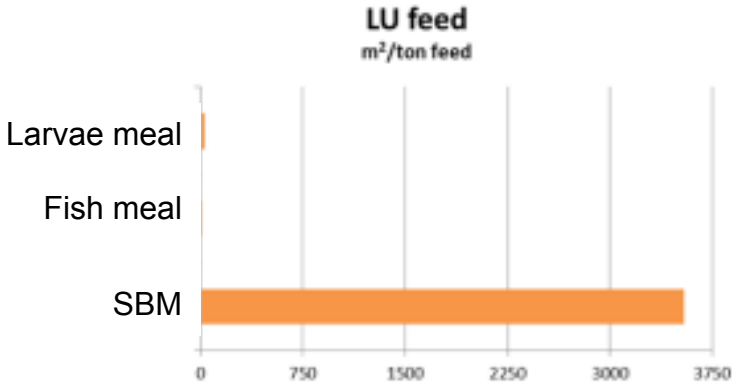
Reduction of E. coli *O157:H7 by soldier fly larvae in different types of manure. Two independent trials were conducted for both chicken and hog manure* (n = 2), *whereas only one trial* (n = 1) *was conducted for cow manure systems. All samples contained 75 g of manure, and treated samples also contained 7 g of soldier fly larvae. Samples were stored at 27°C.*

Source: Erickson et al 2004

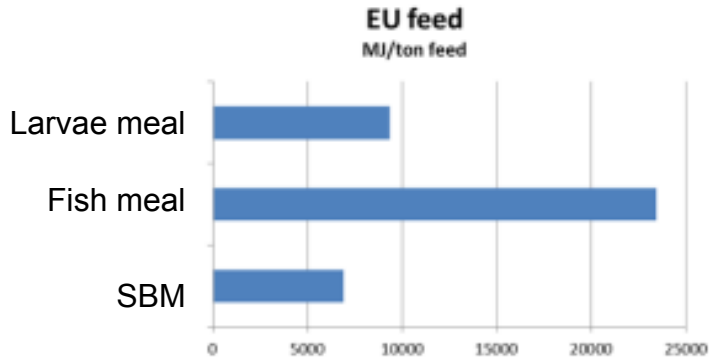
Research and application: Environmental influence



Global warming potential by producing insect meal fishmeal and soybean meal



Land use producing insect meal fishmeal and soybean meal



Energy use producing insect meal fishmeal and soybean meal

Source: Zanten et al, 2014

Research and application: Investigation on rainbow trout

- BSF-Larvae produced on food waste rich in carbon-hydrates
- Harvested in the pre-pupae stage
- Dried, grinded and defatted
- Experimental fish feed on base of HM (50% fish meal replacement)
- Experimental- and control feed iso-caloric (18,4 MJ/kg) but not iso-nitrogeneous (49,1% / 45,7%)

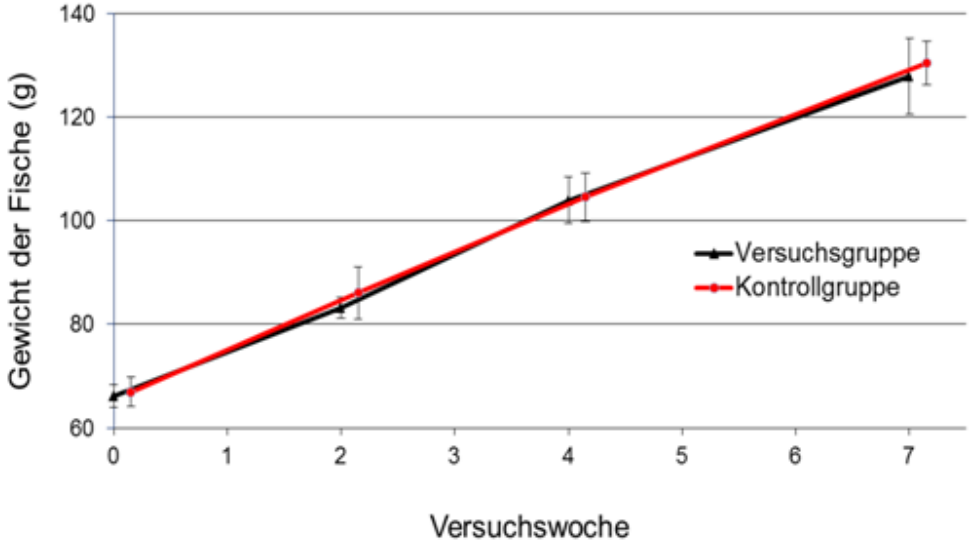
Source: Buser, 2014

Research and application: Feed- Performance

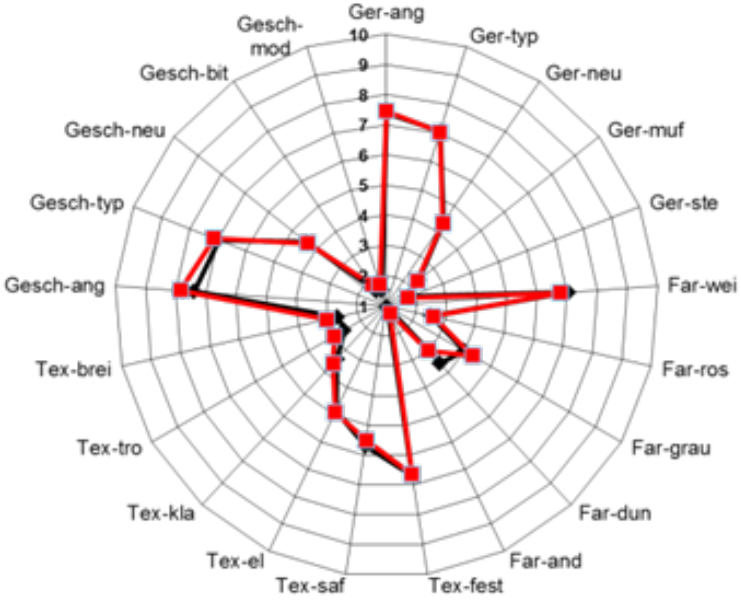
Feeding trial on rainbow trout:

- 3 replicates / treatment
- 3000 fish / replicate

Trout growth



Results of degustation



Experimental group
Control

Ger-ang:	smell pleasant
Ger-typ:	smell typical
Ger-muf:	smell muddy
Ger-str:	smell strong
Far-wei:	colour white
Far-ros:	colour pink
Far-dun:	colour dark
Far-and:	colour different
Tex:-fest:	texture firm
Tex-saf:	texture juicy
Tex-el:	texture elastic
Tex-gap:	texture gaping
Tex-tro:	texture dry
Tex-brei:	texture pulpy

Source: Buser, 2014

Conclusion:
Expectations for the organic market

- The protein gap in production of organic feeds might be closed by insect proteins (IP)
- The question whether IP produced on conventional or organic feed stock needs to be answered
- The organic sector should find sustainable ways of utilising agricultural waste.
- Organic farmers should look into the alternatives of waste reuse and benefit from new research techniques
- Policy makers are expected to work ASAP on new regulations concerning insect technologies

Thank you very much!

Appendix I:

Literature cited:

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- van Zanten Hannah H.E. , Dennis G.A.B. Oonincx, Herman Mollenhorst, Paul Bikker, Bastiaan G. Meerburg, Imke J.M. de Boer (2014) Can the environmental impact of livestock feed be reduced by using waste-fed housefly larvae? Proceedings of the 9th International Conference on Life Cycle Assessment in the Agri-Food Sector (LCA Food 2014), 8-10 October 2014, San Francisco, USA.ACLCA, Vashon, WA, USA

Appendix II: EU regulations and directives

- (EC) 178/2002: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2002:031:0001:0024:en:PDF
- (EC) 854/2004: http://www.cefas.defra.gov.uk/media/455777/extract_reg_no_854_2004.pdf
- (EC) 183/2005: http://www.food.gov.uk/sites/default/files/multimedia/pdfs/regulationec1832005.pdf
- (EC) 2002/32 : http://eurl.craw.eu/img/page/Legislation/32_2002.pdf
- (EC) 1069/2009: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:300:0001:0033:EN:PDF
- (EC) 999/2001: http://ec.europa.eu/food/fs/afs/marktlab/marktlab14_en.pdf

Appendix III:

Contents of AS in Hermetia meal and fish meal

Aminosäure (g/100g) (essentielle Fettsäuren fettgedruckt)	Hermetia (fed on carbon hydrate rich feeds)	fishmeal 68% CP	requirement rainbow trout	Requirement layer hen	Comparison Hermetia/ Fishmeal [%]
	De-oiled	De-oiled	(g/100g feed)	(g/100g feed)	
Aspartic acid	6.56	6.05			108.4
Threonine	2.77	2.30	1.1	0.50	120.4
Serine	3.02	2.55			118.4
Glutamic acid	6.95	7.94			87.5
Glycine	4.53	5.98			75.8
Alanine	4.41	4.33			101.8
Cysteine	0.39	0.43	0.4		90.7
Valine	4.51	2.93	1.2		153.9
Methionine	1.25	1.60	0.7	0.3	78.1
Methionine + Cystine	1.64	2.03	1.1	0.6	80.8
Isoleucine	3.15	2.28	1.1		138.2
Leucine	5.07	4.16	1.5		121.9
Tyrosine	4.48	1.48			302.7
Phenylalanine	2.83	2.18	0.9		129.8
Phenylalanine + Tyrosine	7.31	3.66	1.8		199.7
Histidine	2.08	1.77	0.8		117.5
Lysine	3.63	4.09	2.4	0.7	88.8
Arginine	3.33	3.53	1.5		94.3
Proline	4.08	3.69			110.6

Appendix IV:

Proximate analyses of experimental and control diet

Ergebnisse Proximatanalyse [g/kg TM]	Hermetia-futter	Kontroll-futter
Trockenmasse	942	931
Protein	491	457
Fett	126	151
Asche	126	134
Rohfaser	44	13
Stickstofffreie Extrakte	164	189
Brutto Energie [MJ/kg]	22.2	21.2

Appendix V:

Experimental fish farm New Valfish; Le Bouveret, Wallis