Content Appendix:

Appendix 1A - Search strategy, search terms and selection strategy for literature on plant health

1.1 Plant diseases

Search strategy

Search strategies were developed using the databases' subject headings, as well as text words in title/abstract. The search strategy identified 5351 references.

Study/literature selection strategies

The search strategy identified 147 relevant references. Additional search (Google Scholar[1] and papers identified from reference lists of assessed papers) identified 16 potentially relevant papers based on title and abstract. Assessment of the full text versions of 163 studies resulted in the exclusion of 122 papers, and 41 papers were included in the report. Relevant data were extracted and entered into summary tables:

Appendix 2A: Cereal diseases (Tab. 1), Potato diseases (Tab.2), Apple diseases (Tab.3), Strawberry diseases (Tab.4), Field vegetable diseases (Tab.5)

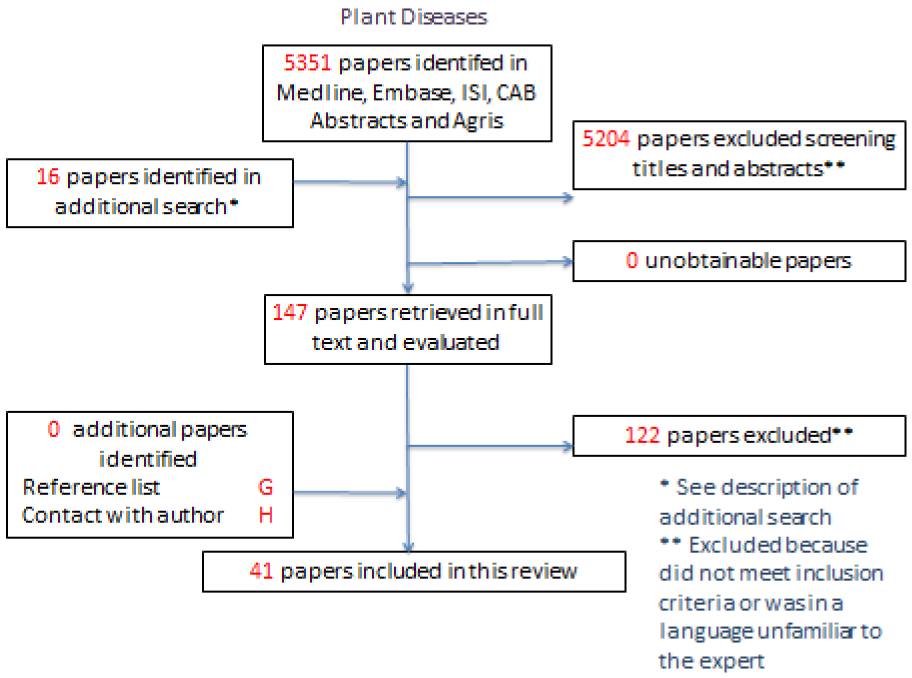

Figure 1. The literature/study selection process of Plant Diseases

Search terms

Solanum tuberosum or potato* or secale cereal or secale or rye or poacea* or grass* or graminea* or cereal* or triticum or triticum aestivum or hordeum or barley* or hordeum vulgare or avena sativa or oat* or fruit* or berry or berries or malus or apple* or prunus or plum or plums or cherry or cherries or fragaria* or strawberry* or rubus or raspberr* or bilberr* or blackcurrant* or currant* or ribes or ribe or vegetable* or daucus carota or carrot* or brassica or cauliflower* or cabbage* or brassica napus or cauliflower* or turnip* or rutabaga or onion* or allium or leek or lycopersicon esculentum or lycopersicon or tomato* or cucumis sativus or cucumber* or lettuce or lactuca sativa or salad vegetable* or leaf vegetable* or leafy vegetable* or rocket

AND

late blight or phytophthora infestans* scab or streptomyces* dry rot or boermia* black leg or phoma* soft rot or pectobacterium* powdery mildew or erysiphe or blumeria graminis* leaf blotch or mycosphaerella or phaeosphaeria* take all or gaeumannomyces graminis* eyespot or oculimacula or pseudocercosporella* rust or puccinia* glume blotch or leptosphaeria* sharp eyespot or rhizoctonia* fusaria or ear blight or foot rot or fusarium* root rot or bipolaris or cochliobolus* apple scab or venturia* powdery mildew or podosphaera* canker or nectria* white rot or schizophyllum* bulls eye rot or neofabrea* brown rot or monilinia* grey mould or botrytis* wilt or verticillium* podosphaera* sphaerotheca* white rot or sclerotinia* liqourice rot or mycocentrospora* cavity spot or pythium* root rot or aphanomyces* clubroot or plasmodiophora* plant disease* plant health* fungus* fungal* rot* root rot*

AND

organic* or ecologic* or biodynamic*

AND

conventional* or integrated

1.2 ARTHROPODS

Search strategy

Search strategies were developed using the databases' subject headings, as well as text words in title/abstract. The search strategy identified 5351 references.

Study/literature selection strategies

The search strategy identified 89 relevant references. Additional search (Google Scholar[1] and papers identified from reference lists of assessed papers) identified 8 potentially relevant papers based on title and abstract. Assessment of the full text versions of 89 studies resulted in the exclusion of 14 papers, and 75 papers were included in the report. For additional references including review papers, Google Scholar was used 22 April 2013. Key words for searching: Organic Farming, Conventional Farming, Insect Pests, Natural Enemies. The first 150 references were surveyedRelevant data were extracted and entered into summary table :

Appendix 2A (Tab. 6)

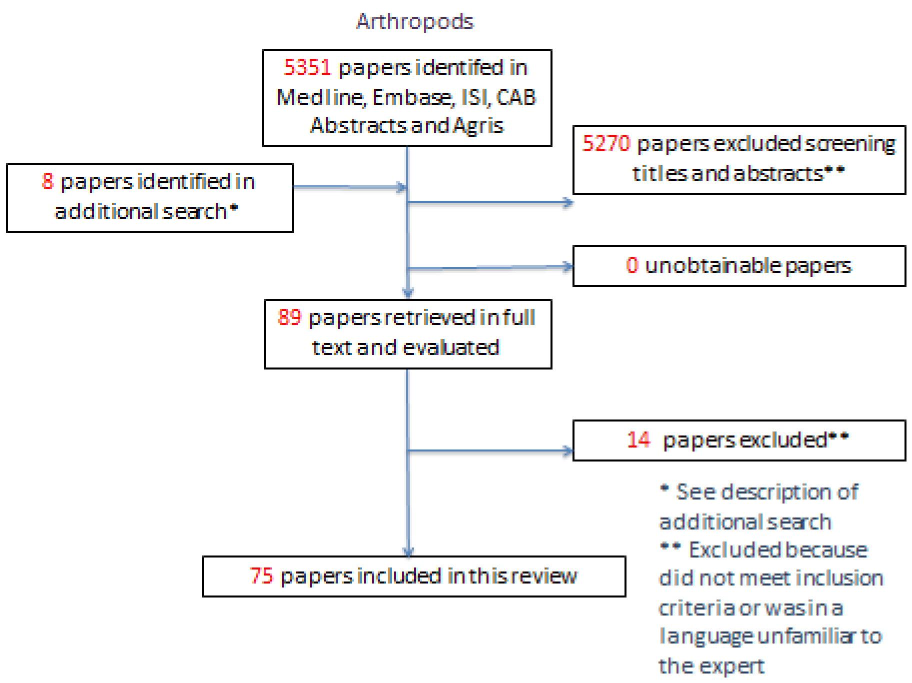

Figure 2. **The literature/study selection process of Plant Pests (arthropods)**

Search terms

Solanum tuberosum or potato* or secale cereal or secale or rye or poacea* or grass* or graminea* or cereal* or triticum or triticum aestivum or hordeum or barley* or hordeum vulgare or avena sativa or oat* or fruit* or berry or berries or malus or apple* or prunus or plum or plums or cherry or cherries or fragaria* or strawberr* or rubus or raspberr* or bilberr* or blackcurrant* or currant* or ribes or ribe or vegetable* or daucus carota or carrot* or brassica or cauliflower* or cabbage* or brassica napus or cauliflower* or turnip* or rutabaga or onion* or allium or leek or lycopersicon esculentum or lycopersicon or tomato* or cucumis sativus or cucumber* or lettuce or lactuca sativa or salad vegetable* or leaf vegetable* or leafy vegetable* or rocket

AND

blight* or Phytophthora infestans* or scab or streptomyces* or fusarium* or "dry rot" or gangrene* or Boeremia* or Phoma or "black leg*" or blackleg or soft rot* or Pectobacterium or erwinia or powdery mildew or Blumeria graminis or leaf blotch or Septoria or Stagonospora nodorum or Leptosphaeria nodorum or Mycosphaerella graminicola or take-all or Gaeumannomyces graminis or bunt or tilletia or Ustilago* or loose smut* or Erysiphe* or net blotch* or Drechslera or Pyrenophora or barley stripe or leaf spot* or Ascomycet* or venturia or Spiloca* or canker* or candida or Monilia or Monilinia or Nectria galligena or brown rot* or plum pocket* or Taphrina pruni* or Taphrina* or Fusicladium* or anthracnose* or Glomerella* or Colletotrichum* or Botrytis* or grey mould* or Phytophthora* or red core* or Podosphaera* or Sphaerotheca* or Didymella* or Godronia* or dieback or Mycosphaerella or Septoria or Mycocentrospora or Fibularhizoctonia* or Rhizoctonia* or white mold* or cottony rot* or root rot* or Aphanomyc* or Pythium* or cavity spot* or Leptosphaeria maculans* or Hyaloperonospora parasitic* or Peronospora or white rot* or ascomycot* or Sclerotini* or pod spot* or spot or spots or chocolate spot* or Plasmodiophor* or clubroot* or stem rot* or Bremia lactucae* or plant disease* or plant health* or plant pest* or pest or pests or natural enem* or insect or insects or nematod* or rot or rots or rotten or rotting or weed* or fungus or fungi or fungal

AND

organic* or ecologic* or biodynamic*

AND

conventional* or integrated

1.3 NEMATODES

Search strategy

Search strategies were developed using the databases' subject headings, as well as text words in title/abstract. The search strategy identified 5351 references.

Study/literature selection strategies

The search strategy identified 19 relevant references. 5 papers were unavailable. Additional search (Google Scholar[1] and papers identified from reference lists of assessed papers) identified 5 potentially relevant papers based on title and abstract. Assessment of the full text versions of 14 studies resulted in the exclusion of 1 paper, and 13 papers were included in the report. Relevant data were extracted and entered into summary table:

Appendix 2A (Tab. 8)

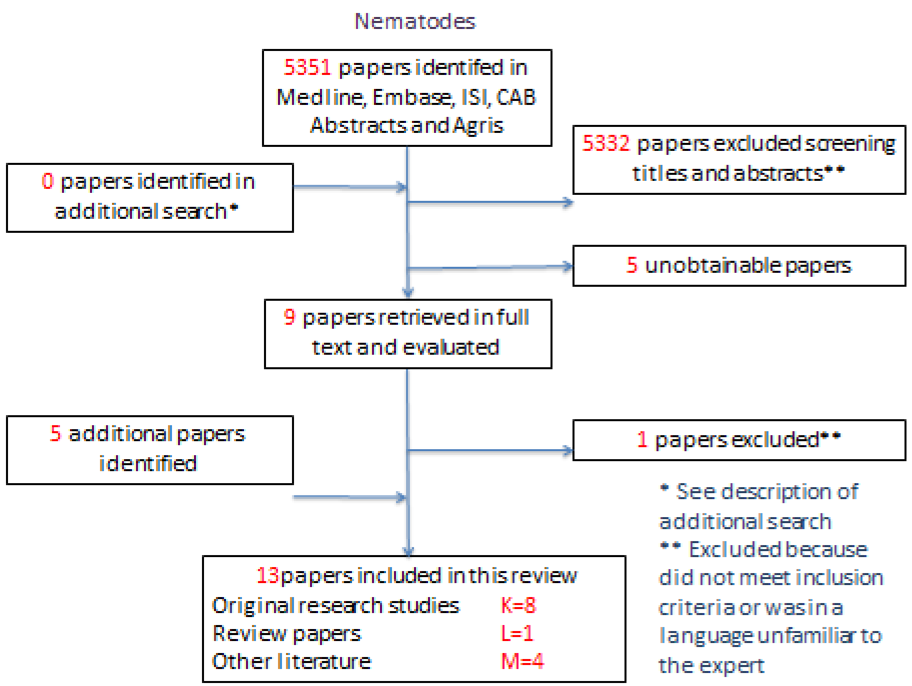

Figure 3. The literature/study selection process of Nematodes

Search terms

Solanum tuberosum or potato* or secale cereal or secale or rye or poacea* or grass* or graminea* or cereal* or triticum or triticum aestivum or hordeum or barley* or hordeum vulgare or avena sativa or oat* or fruit* or berry or berries or malus or apple* or prunus or plum or plums or cherry or cherries or fragaria* or strawberr* or rubus or raspberr* or bilberr* or blackcurrant* or currant* or ribes or ribe or vegetable* or daucus carota or carrot* or brassica or cauliflower* or cabbage* or brassica napus or cauliflower* or turnip* or rutabaga or onion* or allium or leek or lycopersicon esculentum or lycopersicon or tomato* or cucumis sativus or cucumber* or lettuce or lactuca sativa or salad vegetable* or leaf vegetable* or leafy vegetable* or rocket

AND

blight* or Phytophthora infestans* or scab or streptomyces* or fusarium* or "dry rot" or gangrene* or Boeremia* or Phoma or "black leg*" or blackleg or soft rot* or Pectobacterium or erwinia or powdery mildew or Blumeria graminis or leaf blotch or Septoria or Stagonospora nodorum or Leptosphaeria nodorum or Mycosphaerella graminicola or take-all or Gaeumannomyces graminis or bunt or tilletia or Ustilago* or loose smut* or Erysiphe* or net blotch* or Drechslera or Pyrenophora or barley stripe or leaf spot* or Ascomycet* or venturia or Spiloca* or canker* or candida or Monilia or Monilinia or Nectria galligena or brown rot* or plum pocket* or Taphrina pruni* or Taphrina* or Fusicladium* or anthracnose* or Glomerella* or Colletotrichum* or Botrytis* or grey mould* or Phytophthora* or red core* or Podosphaera* or Sphaerotheca* or Didymella* or Godronia* or dieback or Mycosphaerella or Septoria or Mycocentrospora or Fibularhizoctonia* or Rhizoctonia* or white mold* or cottony rot* or root rot* or Aphanomyc* or Pythium* or cavity spot* or Leptosphaeria maculans* or Hyaloperonospora parasitic* or Peronospora or white rot* or ascomycot* or Sclerotini* or pod spot* or spot or spots or chocolate spot* or Plasmodiophor* or clubroot* or stem rot* or Bremia lactucae* or plant disease* or plant health* or plant pest* or pest or pests or natural enem* or insect or insects or nematod* or rot or rots or rotten or rotting or weed* or fungus or fungi or fungal* or Ditylenchus dipsaci* or Stem nematode* or Ditylenchus destructor* or Potato rot nematode* or Pratylenchus * or Root lesion nematode * or Tylenchorhynchus* or Stunt nematode* or Amplimerlinius* or Stunt nematode* or Merlinius * or Stunt nematode* or Geocenamus* or Stunt nematode* or Paratylenchus* or Pin nematode* or Helicotylenchus* or Spiral nematode* or Rotylenchus* or Spiral nematode* or Rotylenchulus* or Reniform nematode* or Heterodera* or Cyst nematode* or Globodera* or Cyst nematode* or Meloidogyne* or Root knot nematode* or Trichodorus* or Stubby root nematode* or Paratrichodorus* or Stubby root nematode* or ongidorus* or Needle nematode* or Xiphinema* or Dagger nematode*

AND

organic* or ecologic* or biodynamic*

AND

conventional* or integrated

1.4 WEEDS

Search strategies

Search strategies were developed using the databases' subject headings, as well as text words in title/abstract. The search strategy identified 5351 references.

Study/literature selection

The search strategy identified 186 relevant references, of which 119 were excluded according to predefined criteria. Additional search (Google Scholar[1] and papers identified from reference lists of assessed papers) identified 27 potentially relevant papers based on title and abstract. Of the selected 94 papers, 3 papers were not able to obtain, which resulted in 91 papers retrieved in full text and evaluated. Relevant data were extracted and entered into summary table:

Appendix 2A (Tab.7)

In addition, 3 textbooks and one report on docks (Rumex spp.) in grassland were used.

[1] Google Scholar November-December 2013. Key words for searching: (1) Weed* and Weed harrow* and Undersow*. (2) Perennial weed* and Plough* (the most relevant references were surveyed)

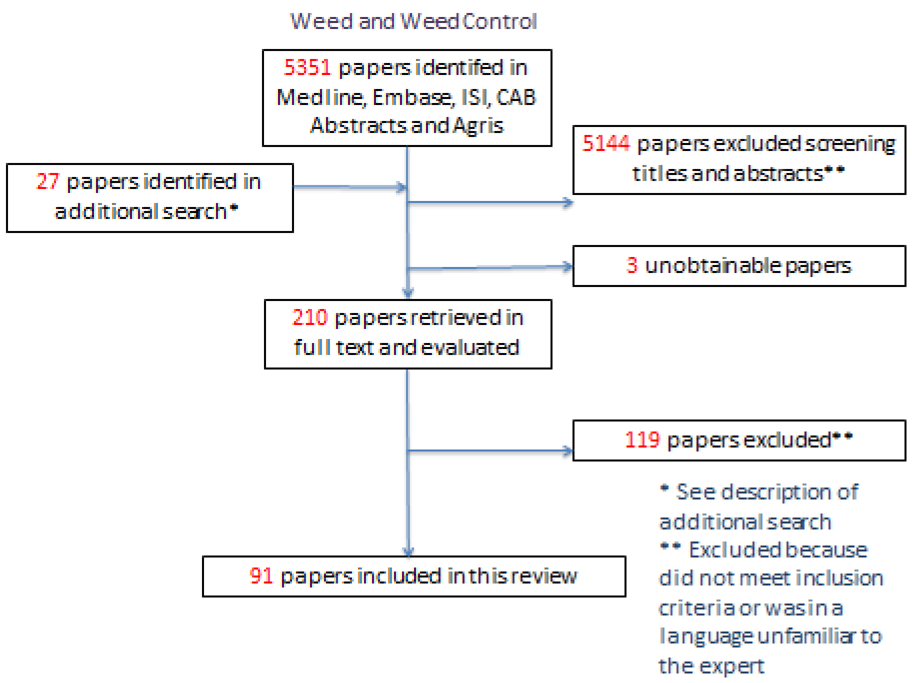

Figure 4. **The literature/study selection process of Weeds and Weed Control**

Search terms

Solanum tuberosum or potato* or secale cereal or secale or rye or poacea* or grass* or graminea* or cereal* or triticum or triticum aestivum or hordeum or barley* or hordeum vulgare or avena sativa or oat* or fruit* or berry or berries or malus or apple* or prunus or plum or plums or cherry or cherries or fragaria* or strawberr* or rubus or raspberr* or bilberr* or blackcurrant* or currant* or ribes or ribe or vegetable* or daucus carota or carrot* or brassica or cauliflower* or cabbage* or brassica napus or cauliflower* or turnip* or rutabaga or onion* or allium or leek or lycopersicon esculentum or lycopersicon or tomato* or cucumis sativus or cucumber* or lettuce or lactuca sativa or salad vegetable* or leaf vegetable* or leafy vegetable* or rocket

AND

weed*

AND

organic* or ecologic* or biodynamic*

AND

conventional* or integrated

2 Appendix 1B - Search strategy, search terms and selection strategy for literature on content of nutrients

Search terms (for nutrients in fruits, berries, vegetables, potato, cereals, grasslands/forage)

Solanum tuberosum or potato* or secale cereal or secale or rye or poacea* or grass* or graminea* or cereal* or triticum or triticum aestivum or hordeum or barley* or hordeum vulgare or avena sativa or oat* or fruit* or berry or berries or malus or apple* or prunus or plum or plums or cherry or cherries or fragaria* or strawberr* or rubus or raspberr* or bilberr* or blackcurrant* or currant* or ribes or ribe or vegetable* or daucus carota or carrot* or brassica or cauliflower* or cabbage* or brassica napus or cauliflower* or turnip* or rutabaga or onion* or allium or leek or lycopersicon esculentum or lycopersicon or tomato* or cucumis sativus or cucumber* or lettuce or lactuca sativa or salad vegetable* or leaf vegetable* or leafy vegetable* or rocket

AND

food qualit*" or quality or qualities or vitamin* or bioactive compound* or bioactive component* or antioxidant* or chemical composition* or chemical compound* or protein analysis or protein composition* or protein component* or amino acid* or aminoacid* or mineral* or trace element* or metal*

AND

organic* or ecologic* or biodynamic*

AND

conventional* or integrated

2.1 FRUIT

Search strategies

Search strategies were developed using the databases' subject headings, as well as text words in title/abstract. The search strategy identified 6051 references.

Study/literature selection

41 publications were retrieved in full text from the 6051 references found on nutrients, after excluding papers based on titles and abstracts. 8 papers were excluded because they did not meet the selection criteria set to country (2), year (2), statistics (1), fruit species (1) and original papers (2). This gave a total of 33 papers included in the summary table: Appendix 2B (Tab. 9)

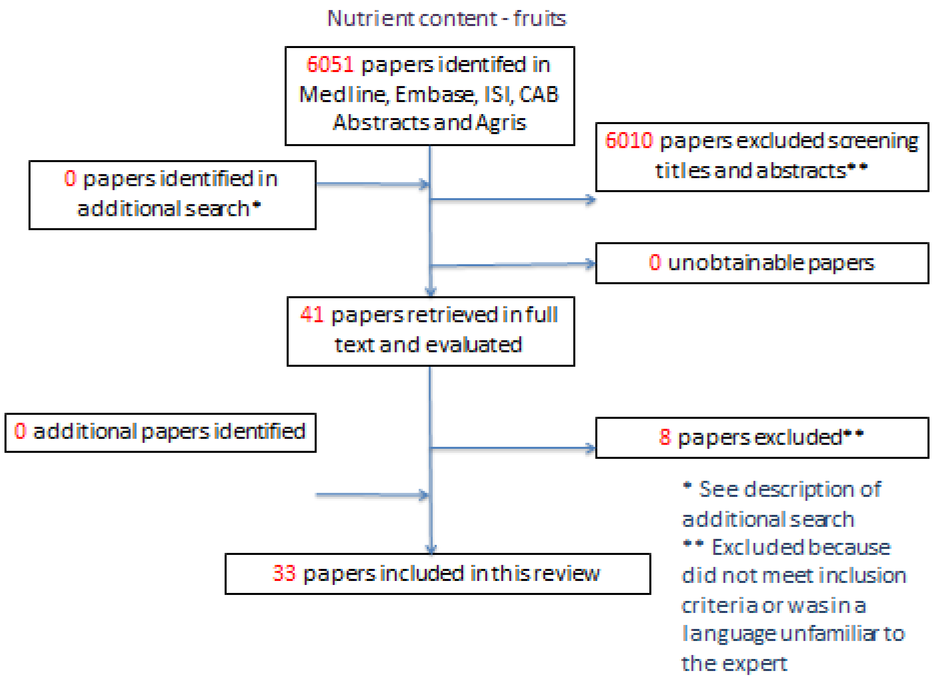

Figure 5 **The literature/study selection process of nutrient content in Fruits**

2.2 BERRIES

Search strategies were developed using the databases' subject headings, as well as text words in title/abstract. The search strategy identified 6051 references.

Study/literature selection

From the 6051 references, one paper was unobtainable, while 31 publications were retrieved in full text. 10 papers were excluded because they did not meet the selection criteria set to country (2), statistics (4), original papers (2), were investigating processed products (1) and not including nutrients in berries (1). This gave a total of 21 papers included in the summary table: Appendix 2B (Tab. 10)

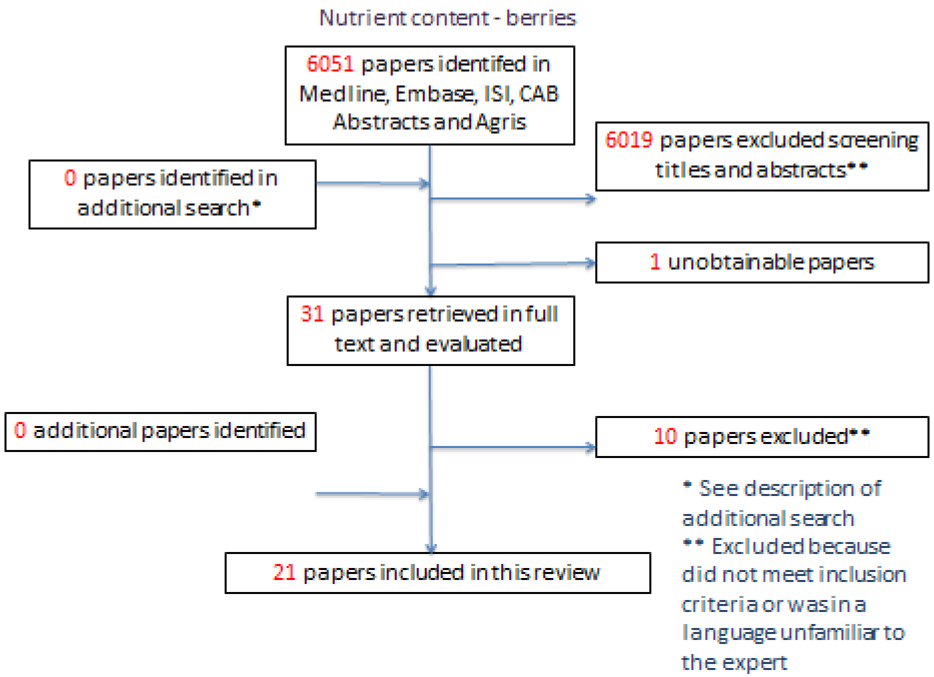

Figure 6. The literature/study selection process of nutrient content in Berries

2.3 Vegetables

Search strategies

Search strategies were developed using the databases' subject headings, as well as text words in title/abstract. The search strategy identified 6051 references.

Study/literature selection

From the 6051 references, five papers were unobtainable, while 59 publications were retrieved in full text. 26 papers were excluded because they did not meet the selection criteria set to country (7), year (2), statistics (5), original papers (7), were investigating processed products (1) and not including nutrients in vegetables (4). This gave a total of 33 papers included in the summary table: Appendix 2B (Tab. 11)

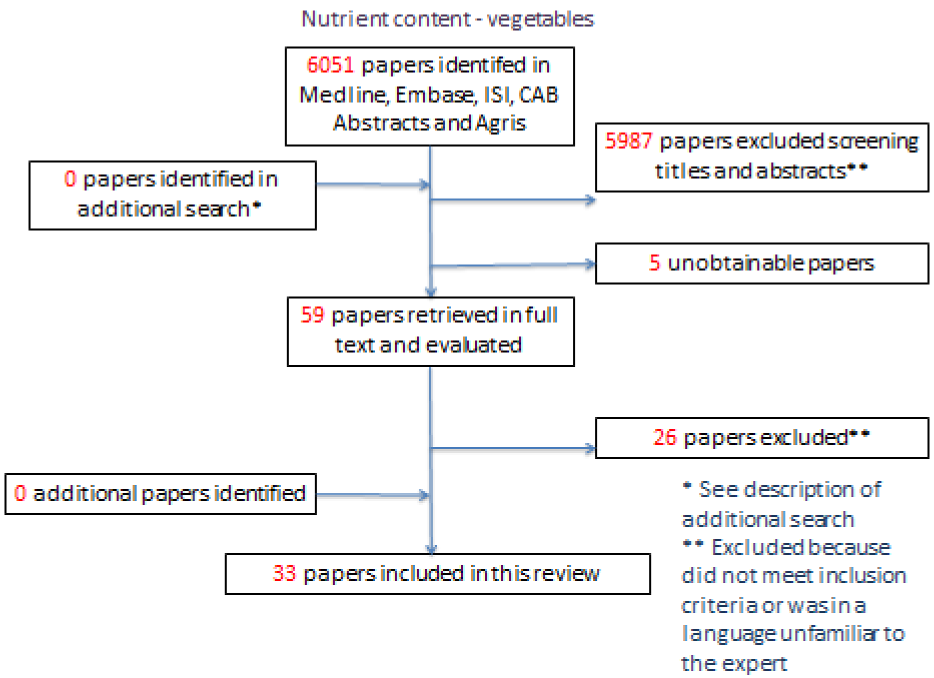

Figure 7. **The literature/study selection process of nutrient content in Vegetables**

2.4 POTATO

Search strategies

Search strategies were developed using the databases' subject headings, as well as text words in title/abstract.

Study/literature selection

The search strategy identified 82 references. Additional search (Google Scholar[1] and papers identified from reference lists of assessed papers) identified 17 potentially relevant papers based on title and abstract. Assessment of the full text versions of 99 studies resulted in the exclusion of 56 papers, and 28 papers were included in the report. Relevant data were extracted and entered into a summary table: Appendix 2B (Tab. 14)

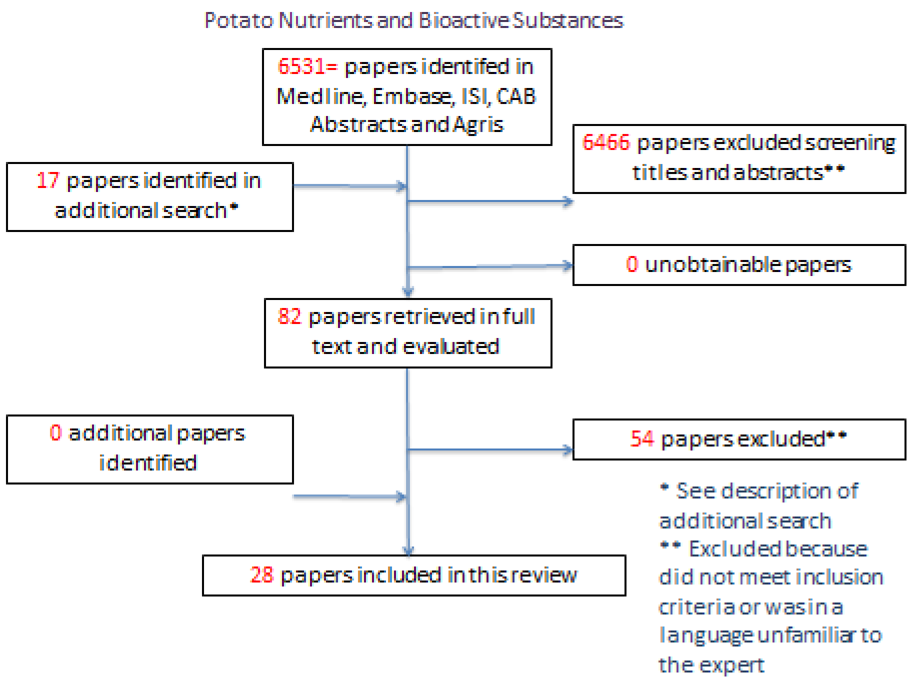

Figure 8. **The literature/study selection process of Potato Nutrients and Bioactive Substances**

Search terms (additional search terms for potato and bioactive substances)

Solanum tuberosum or potato*

AND

dry matter* starch* protein* vitamin C*, chlorogenic acid* glycoalcaloids* nitrate* ash* phosphorus* sugar* potassium* magnesium* calcium* natrium* iron* selenium* mercury* lead* zinc* sulphur* molybdenum* solanine* amino acids*

AND

organic* or ecologic* or biodynamic*

AND

conventional* or integrated

2.5 CEREALS

Search strategies

Search strategies were developed using the databases' subject headings, as well as text words in title/abstract.

Study/literature selection

From the 6051 references, 112 were selected based on reading the titles and abstracts , and selecting the papers on cereals, nutrient content and production system. 12 of these papers could not be obtained. By the assessment of the full text versions of the resulting 100 references, 70 were excluded because they 1) did not cover nutrients in grains (16), 2) did not compare organic and conventional systems or samples(15), 3) were investigating contaminants (10), 4) were investigating processed products (9), or 5) did not met the selection criteria's set to language/country (2), original papers (8) or were published before 1991 (10). Two were reviews, and are cited in the text. Three additional papers were identified by manually examining the reference lists from the selected papers. This gave totally 28 research articles included in the summary table and 5 reviews. Relevant data were extracted and entered into a summary table: Appendix 2B (Tab. 12)

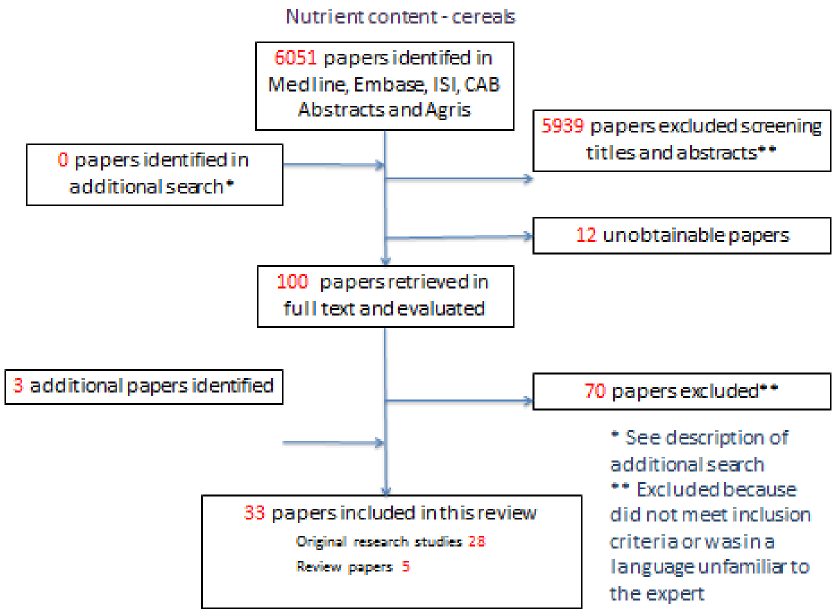

Figure 9. **The literature/study selection process of nutrients in Cereals**

2.6 GRASSLANDS-FORAGE

Search strategies

Search strategies were developed using the databases' subject headings, as well as text words in title/abstract.

Study/literature selection

For forages it was considered that mainly papers from Northern Europe could be relevant due to the species and forage mixtures grown in Norway. From the 6051 references, only 34 were selected based on reading the titles and abstracts, and selecting the papers including forages, grasses, grass and clover species and production system. One paper was found in additional search based on knowledge to research works in Norway. 4 of the selected references could not be obtained. By the assessment of the full text versions of the 31 selected references, only 7 met the selection criteria's. One additional paper was found based on contacts with an author from Norway. This gave only 7 research articles. Relevant data were extracted and entered into a summary table: Appendix 2B (Tab. 13)

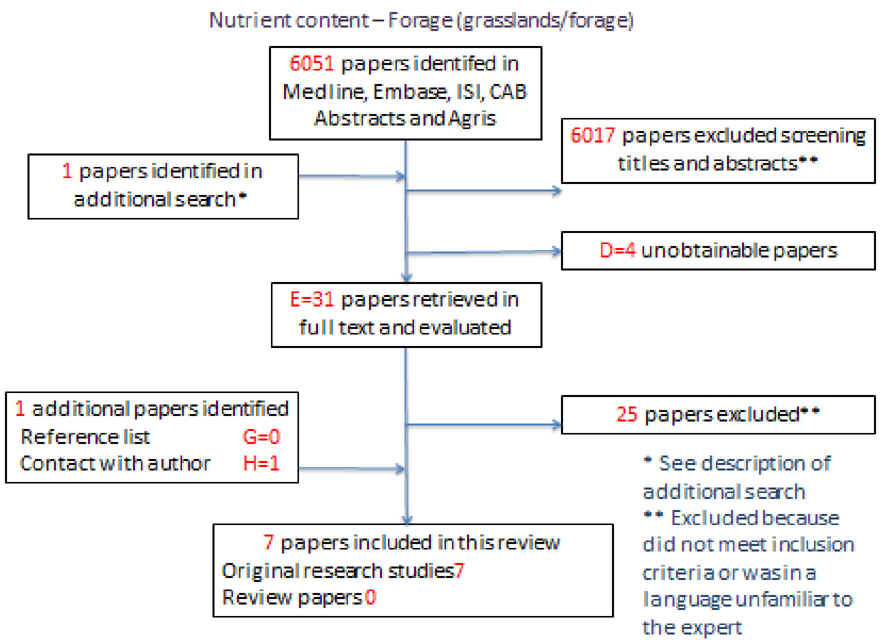

Figure 10. **The literature/study selection process of nutrient content in Grasslands/Forage**

3 Appendix 1C - Search strategy, search terms and selection strategy for literature on environmental contaminants

Search strategies

Search strategies were developed using the databases' subject headings, as well as text words in title/abstract.

Study/literature selection

The search strategy identified 2115 references, of which 2056 were excluded according to predefined criteria. Additional search (Google Scholar[1] and papers identified from reference lists of assessed papers) did not identify any additional papers based on title and abstract. Of the selected 55 papers, 4 were unobtainable. Assessment of the full text versions of 55 studies resulted in the exclusion of 17 papers, ie 38 papers were included in the report. Relevant data were extracted and entered into summary table: Relevant data were extracted and entered into a summary table: Appendix 2C (Tab. 15 + 16)

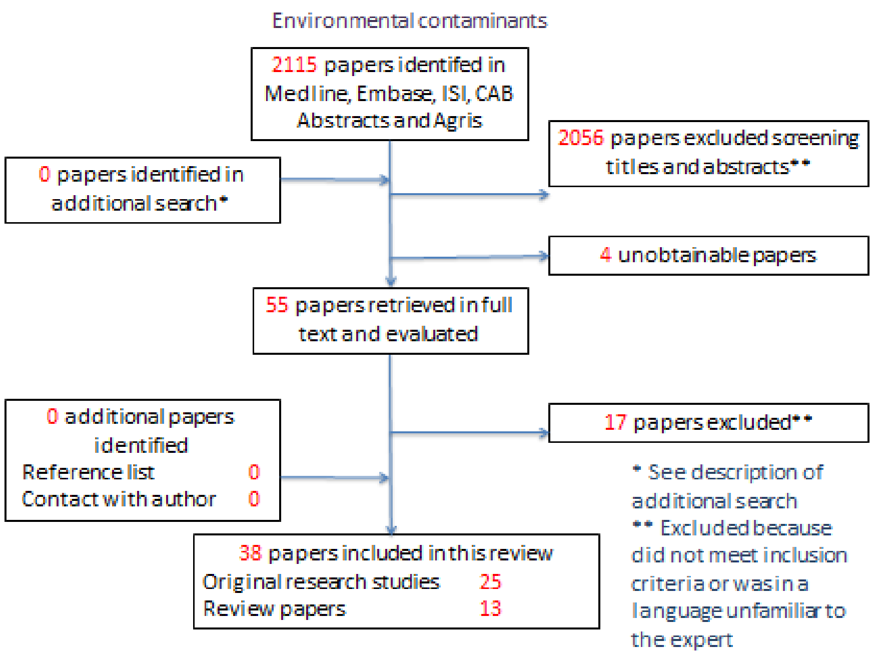

Figure 11. The literature/study selection process of Environmental Contaminants

Search terms

Solanum tuberosum or potato* or secale cereal or secale or rye or poacea* or grass* or graminea* or cereal* or triticum or triticum aestivum or hordeum or barley* or hordeum vulgare or avena sativa or oat* or fruit* or berry or berries or malus or apple* or prunus or plum or plums or cherry or cherries or fragaria* or strawberr* or rubus or raspberr* or bilberr* or blackcurrant* or currant* or ribes or ribe or vegetable* or daucus carota or carrot* or brassica or cauliflower* or cabbage* or brassica napus or cauliflower* or turnip* or rutabaga or onion* or allium or leek or lycopersicon esculentum or lycopersicon or tomato* or cucumis sativus or cucumber* or lettuce or lactuca sativa or salad vegetable* or leaf vegetable* or leafy vegetable* or rocket

AND

Cadmium (Cd) or Phthalates (DEHP, DBP) or Lead (Pb) or -Octylphenols or octylphenol ethoxylates or Mercury (Hg) or Nonylphenols and nonylphenol ethoxylates or Nickel (Ni) or Zink (Zn) or Polychlorinated biphenyls (PCBs) or Cobber (Cu) or Polycyclic aromatic hydrocarbons (PAHs) or Chromium (Cr) or dioxin or Polychlorinated dibenzodioxins or organic mercury or methylmercury or heavy metals or organic contaminants or POPs.

AND

organic* or ecologic* or biodynamic*

AND

conventional* or integrated

4 Appendix 1D - Search strategy, search terms and selection strategy for literature on mycotoxins

Search strategies

Search strategies were developed using the databases' subject headings, as well as text words in title/abstract.

Study/literature selection

The search strategy identified 167 references, of which 91 were excluded according to predefined criteria. Additioal search (Google Scholar[1] and papers identified from reference lists of assessed papers) identified 18 potentially relevant papers based on title and abstract. Of the selected 94 papers, 3 were not able to obtain. Assessment of the full text versions of 91 studies resulted in the exclusion of 46 papers, ie 45 papers were included in the report. Relevant data were extracted and entered into summary table: Relevant data were extracted and entered into a summary table: Appendix 2D (Tab. 17)

[1] Google Scholar 1 December 2013. Key words for searching: Mycotoxins organic conventional farming (the first 100 references were surveyed). Mycotoxins organic conventional cereals (the first 100 references were surveyed)

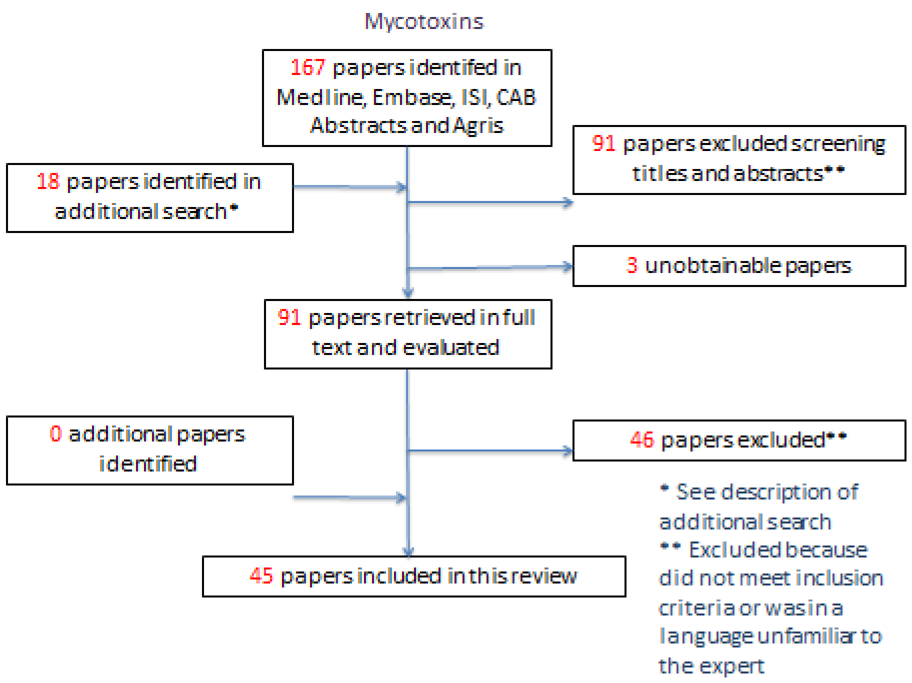

Figure 12. **The literature/study selection process of mycotoxins**

Search terms

Solanum tuberosum or potato* or secale cereal or secale or rye or poacea* or grass* or graminea* or cereal* or triticum or triticum aestivum or hordeum or barley* or hordeum vulgare or avena sativa or oat* or fruit* or berry or berries or malus or apple* or prunus or plum or plums or cherry or cherries or fragaria* or strawberr* or rubus or raspberr* or bilberr* or blackcurrant* or currant* or ribes or ribe or vegetable* or daucus carota or carrot* or brassica or cauliflower* or cabbage* or brassica napus or cauliflower* or turnip* or rutabaga or onion* or allium or leek or lycopersicon esculentum or lycopersicon or tomato* or cucumis sativus or cucumber* or lettuce or lactuca sativa or salad vegetable* or leaf vegetable* or leafy vegetable* or rocket

AND

mycotoxin* or beauvericin* or vomitoxin* or deoxynivalenol* or 6 diazo 5 oxonorleucine or enniatin* or fumonisin* or "T 2 toxin* or HT 2 toxin* or moniliformin* or nivalenol* or zearalenon* or aflatoxin* or ochratoxin* or patulin*

AND

organic* or ecologic* or biodynamic*

AND

conventional* or integrated

5 Appendix 1E - Search strategy, search terms and selection strategy for literature on seed quality

Search strategies

Search strategies were developed using the databases' subject headings, as well as text words in title/abstract.

Study/literature selection

The search strategy identified 1540 references, of which 1504 were excluded according to predefined criteria. Additioal search (Google Scholar[1] and papers identified from reference lists of assessed papers) identified 12 potentially relevant papers based on title and abstract. Of the selected 48 papers, 2 were not able to obtain. Assessment of the full text versions of 46 studies resulted in the exclusion of 37 papers, ie 9 papers were included in the report. Relevant data were extracted and entered into summary table: Relevant data were extracted and entered into a summary table: Appendix 2E (Tab. 118)

[1] Google Scholar 22 November 2013. Key words for searching: Organic conventional seed quality germination capacity purity (the first 100 references were surveyed).

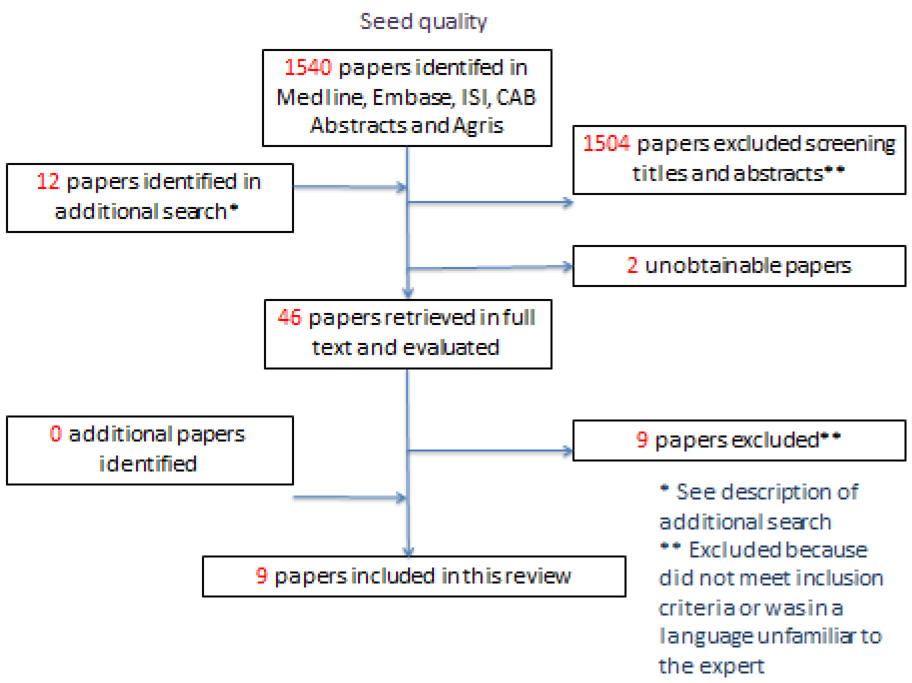

Figure 13. The literature/study selection process of Seed Quality

Search terms

rye or secale cereal* or secale or poaceae or grass* or graminea* or cereal* or wheat* or triticum or barley or hordeum or oat or oats or avena sativa or plant seed* or vegetable seed* or seed* or carrot* or daucus carota or cabbage* or brassica or cauliflower* or onion* or allium or leek* or pea or peas or pisum or vicia faba* or faba bean* or fabaceae* or broad bean* or brassica rapa* or rapeseed* or oilseed rape

AND

seed qualit* or seed purit* or germinat* or fusarium* or seedling blight* or crown rot* or gibberella* or claviceps or ergot or glume blotch* or Stagonospora nodorum or Septoria nodorum or common bunt* or stinking smut* or Tilletia or Drechslera or Pyrenophora or Ustilago or stalk smut* or urocystis or stem rot* or Sclerotinia sclerotiorum or black leg* or blagleg* or Leptosphaeria maculans or Leptospheria maculans or grey leaf spot* or alternaria or black spot* or pod spot* or Ascomycet* or Botrytis or Mycospherella or Phoma or black root rot* or white mould* or neck rot* or white rot* or white rot* or Sclerotinia or seed borne or seedborne or leaf blotch* or net blotch* or leaf stripe* or leaf spot* or smut or stem smut* or chocolate spot* or foot rot* or leaf blight* or seedling blight* or grey mould* or purple blotch* or disease* or pathogen*

AND

organic* or ecologic* or biodynamic*

AND

conventional* or integrated

6 Appendix 1F - Search strategy, search terms and selection strategy for literature on seed potato quality

Search strategies

Search strategies were developed using the databases' subject headings, as well as text words in title/abstract.

Study/literature selection

The search strategy identified 540 references, of which 529 were excluded according to predefined criteria. Additioal search (Google Scholar[1]) identified 3 potentially relevant papers based on title and abstract (=14 papers). Of the 14 papers, 4 were not able to obtain. Assessment of the full text versions of 10 studies resulted in the exclusion of 8 papers, ie only two papers were included in the report. Relevant data were extracted and entered into summary table: Relevant data were extracted and entered into a summary table: Appendix 2F (Tab. 19)

[1] Google Scholar 20 December 2013. Key words for searching: Organic conventional seed potatoes (the first 100 references were surveyed).

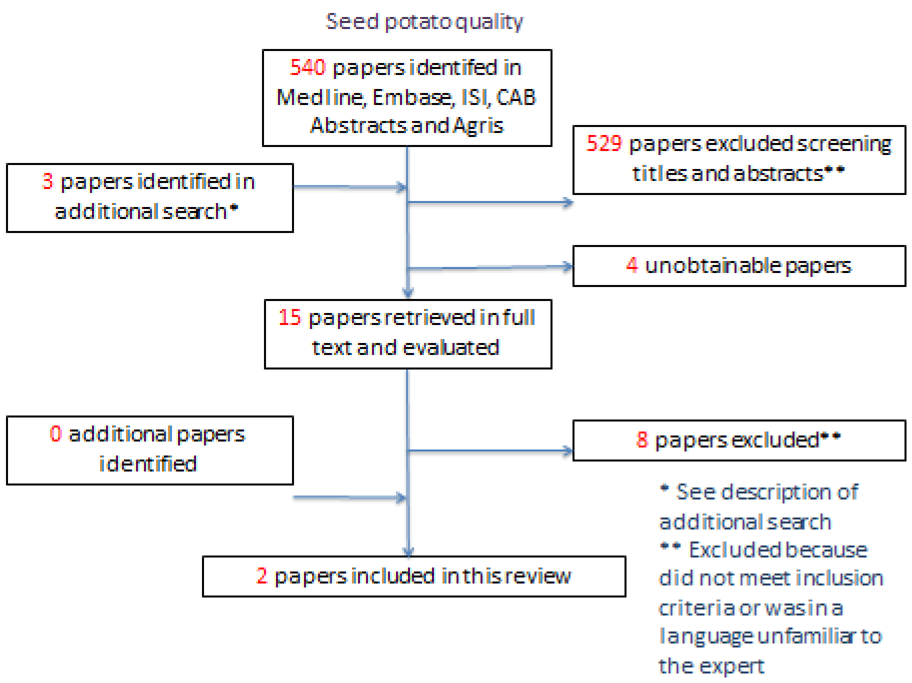

Figure 14. The literature/study selection process of Seed Potato Quality

Search terms

solanum tuberosum or potato* or seed potato*

AND

seed quality* or seed purity or tuber size* or frost damage* or heat damage* or dry damage* or shrivel* or sprout* or soil adher* or adher* soil* or mechanical damage* or misshaped tuber* or abnormal tuber* or tuber development* or different type* or different cultivar* or different variet* or diverging type* or diverging cultivar* or diverging variet* or plant disease* or disease* or pest* or plant virus* or visible virus* or potyvirus* or potato virus y or potato virus s or potato virus a or potexvirus* or potato virus x or potato virus m or mosaic virus* or mottle virus* or potato Aucuba mosaic virus* or PAMV or soil borne virus* or soilborne virus* or tobacco rattle virus* or TRV or potato mop-top virus or black leg* or blackleg* or dickey or erwinia or soft rot* or pectobacterium or pectobacterium carotovorum or pectobacterium chrysanthemi or phytophthora infestans or tuber blight* or late blight* or fusarium or dry rot* or gangrene* or phoma foveata* or phoma or Streptomyces or common scab* or hyphomycetes or helminthosporium or silver scurf*

AND

organic* or ecologic* or biodynamic*

AND

conventional* or integrated

Appendix 2A - Data extracted from included studies on plant health

6.1 Plant diseases

Table 1. Results from included studies on cereal diseases

Study	Location	Study type	System	Parameters	Key results
Gosme et al. 2012	France, 50 km west of Paris	Farm survey	Organic and conventional	Leaf blotch (*Mycosphaerella graminicola*) and powdery mildew *(Blumeria graminis)*	Leaf blotch was most severe on conventional wheat both years (numbers not given). Powdery mildew varied in severity between the cropping systems during the two years.
Lemanczyk 2012	Poland	Field trial	Organic, integrated and conventional	Sharp eyespot (*Rhizoctonia cerealis*)	At the milk ripeness stage the sharp eyespot disease index was higher in organic (3.6) and conventional (3.8) than in integrated wheat (0.8).
Bernhoft et al. 2010	Norway	Farm survey	Organic and conventional	Fusaria (*Fusarium* spp.)	Fusaria incidence was higher in conventional than organic cereals. For barley the mean percentages were: conventional (85%) and organic (81%), for oats: conventional (86%) and organic (81%) and for wheat: conventional (75%) and organic (64%).
Matusinsky et al. 2008	Czech Republic, Kroměříž	Field trial, 1 year	Organic and conventional	Eyespot (*Oculimacula* spp), sharp eyespot and snow mould (*Microdochium nivale*), fusaria	For sharp eyespot there were only small differences in disease incidence between the cultivation systems. Eyespot and snow mould occurred in highest frequencies under conventional farming (numbers not given). Only low levels of *F. avenaceum* were detected by PRC.
Kristensen and Ericson 2008	Denmark and Northern Sweden	Field trials	Organic and conventional	Net blotch (*Pyrenophora teres*), barley scald (*Rhyncohsporium secalis*), powdery mildew, leaf rust of barley (*Puccinia hordei*)	Statistical analyses showed that diseases seemed to have a less negative effect on yield in the organic growing system than in the conventional system if pesticides were not applied (numbers not given).

Study	Location	Study type	System	Parameters	Key results
Cooper et al. 2007	United Kingdom, Northumer-land	Field trial	Organic, integrated and conventional	Powdery mildew, barley scald, net blotch	Powdery mildew incidence was lower on organic (70 % of conventional) and integrated (38 % of conventional) then on conventional barley. Net blotch was least severe in integrated (6 % of conventional), while organic had most net blotch (111 % of conventional). Barley scald was more severe on organic (776 % of conventional) and integrated (356 % of conventional) then on conventional barley.
Baturo 2007	Poland	Field trial, 5 years	Organic, integrated and conventional	Common root rot (*Cochliobolus sativus* syn. *Bipolaris sorokiniana*), *Fusarium* root rot	In spring barley the disease index for symptoms caused by both pathogens at beginning of tillering was higher on organic (8.5) then on integrated (1.9) and conventional (1.3). Also at the dough maturity stage disease index was higher for organic (32.8) than for integrated (22.6) and conventional (27.3)
Baeckström et al 2006	Sweden, Ørebro, Kvinnersta Exp. farm	Field trial, 3 years	Organic Conventional	Tan spot (*Pyrenophora tritici-repentis*), glume blotch (*Phaeosphaeria nodorum*), fusaria	PCA analysis showed tan spot incidence was highest on organic wheat, while glume blotch occurrence was highest on conventional wheat. Fusaria were most common on conventional wheat in one year, but there was no difference between organic and conventional wheat in 2 years.
Lukanowski 2005	Poland	Field trial	Organic, integrated and conventional	*Fusarium* root rot	At milk maturity stage the disease index was lower on conventional wheat (11.3) than on organic (15.9) and integrated (15.2) wheat. Total pathogenic *Fusarium* spp. was higher on integrated (28.9%) than on organic (23.6%) and conventional (23.6%) wheat.
Champeil et al 2004	France, Grignon	Field trial, 3 years	Organic, direct drilling, conventional	Fusaria	There was no difference in fusaria incidence between organic and conventional cereals. Direct drilling resulted in higher fusaria incidence.
Birzele et al. 2002	Germany, Rhineland	Farm survey, 4 years	Organic and conventional	Ear blight (*Fusarium* spp.)	The incidence of ear blight, mainly on winter wheat, was higher on conventional than on organic winter wheat (numbers not given)

Study	Location	Study type	System	Parameters	Key results
Knudsen et al. 1999	Denmark, Zealand and Jutland	Farm survey, 5 fields	Organic, integrated and conventional	Suppressiveness toward brown foot rot (*Fusarium culmorum*)	There were only small but non-significant differences in brown foot rot indexes among the cultivation systems in the soils tested.
Eltun 1996a	Norway, Apelsvoll	Field trial, 4 years	Organic, integrated and conventional. Two crop rotations-arable crops and forage crops	Powdery mildew and glume blotch	There were low disease levels and no differences in powdery mildew incidence of barley and oats in any of the cultivation systems. Powdery mildew incidence was higher on organic winter wheat (22%) than in integrated winter wheat (3%) and conventional winter wheat (3%). In spring wheat powdery mildew incidence was higher in organic wheat arable crop (18%) than conventional arable crop wheat (2%). In the rotation with forage crops there was no difference in powdery mildew incidence. Glume blotch incidence was higher in organic winter wheat (36%) than in conventional winter wheat (8%). Also, in spring wheat glume blotch was more severe in organic wheat.
Hannukkala & Tapio 1990	Finland, Jokioinen	Field trial, 3 years	4 conventional and 4 organic cropping systems	*Fusarium* root rot, Common root rot (*Cochliobolus sativus* syn. *Bipolaris sorokiniana*), powdery mildew, fusaria Take all (*Gaumannomyces graminis)* Yellow rust (*Puccinia striiformis*)	In winter wheat powdery mildew, yellow rust and leaf blotch incidence was higher in conventional than in organic cropping systems (numbers not given). Fusaria were more common in conventional than in organic winter wheat in one of two years. Cropping system had no effect on root rot in winter wheat. Foot rot incidence was higher in organic (54%) than in conventional (40%) barley the first year, the second year there was no difference and the third year the incidence on conventional (68%) was higher than on organic (47%) barley. Stem base infection by *C. sativus* was most severe on organic barley then on conventional barley all three years.

Table 2. Results from included studies on potato diseases

Study	Location	Study type	System	Parameters	Key results
Runno-Paurson et al. 2013	Estonia	Field trial, 2 years	Organic and conventional	Late blight (*Phytophthora infestans*)	In 2010 late blight first appeared on 26. July and in 2011 the first appearance of the disease was 1. August. Nine of the cultivars were susceptible, two were very susceptible and the cultivar 'Toluca' was resistant. The authors concluded that susceptible cultivars cannot be grown without chemical control under North-East European conditions.
Palmer et al. 2013	United Kingdom	Field trial, 6 years in rotation	Organic and conventional	Late blight weekly assessment as area under disease progress curve (AUDPC)	There was relative low late blight severity with the exception of one year. Increased incidence of late blight in organic crop protection systems only occurred when conventional fertilization regimes were applied.
Zarzynska and Szutkowska 2013	Poland	Field trial, 3 years	Organic and conventional	Late blight in 4 cultivars with different levels of late blight resistance, from moderately resistant to susceptible	Late blight developed in July. There was no difference in rate of disease development between organic and conventional potato. Slower growth of the foliage in organic potato led to later appearance of the first symptoms. The resistance level of the varieties had greater influence on the rate of late blight epidemics than the cultivation system.
Keiser et al. 2012	Switzer-land	Farm survey, 4 years	Organic, integrated and conventional	Black scurf (*Rhizoctonia solani*) and dry core (*Fusarium caeruleum*).	Dry core was most severe in organic potato (numbers not given). On 29% of the organic field dry core led to price reduction, while in 3 % of the integrated and conventional field dry core led to price reduction. Black scurf was equally prevalent in the 3 cultivation systems.
Lenc et al. 2012	Poland	Field trial, 3 years	Organic and integrated	Sprout rot (*Rhizoctonia solani*), fusarium dry rot (*Fusarium* spp.), black scurf, common scab (*Streptomyces scabies*)	Sprout rot was more severe in organic (26.2%) than in integrated (17.6%) potato. Incidence of Fusarium dry rot was low both in organic (0.9%) and in integrated (2.8%) potato. Black scurf was lower in organic (14.3%) than in integrated (22.5%) potato. There was no difference in common scab prevalence between the cultivation systems.
Lenc 2006	Poland	Field trial, 3 years, 6 cultivars	Organic and integrated	Sprout rot and black scurf, both caused by *Rhizoctonia solani*, common scab, dry core	The prevalence of sprout rot was higher in integrated (40.9%) than in organic (35.1%) potato, while there was no difference in black scurf on tubers. Common scab was more common in integrated (84.4%) than in organic (75.4%) potato. Dry core was sporadic with no difference between the cultivation systems.

Study	Location	Study type	System	Parameters	Key results
Varis et al. 1996	Finland, Lammi	Field experiment, 4 years, 3 cultivars	Organic, integrated and conventional	Late blight	Under organic cultivation the cultivars 'Bintje' (31) and 'Record' (21) had severe late blight on the foliage, while the resistant cultivar 'Matilda' (5) had least disease. On integrated and conventional plots there were only minor differences in late blight incidence between the cultivars. Storage losses, mainly due to late blight, were larger in organic (10.1%) than in integrated (3.7%) and conventional (3.3%) potato.
Povolony 1995	Sweden, Uppland	Field and storage trials, 1 year, 3 varieties	Organic and conventional	Dry core and gangrene (*Boeremia foveata* syn. *Phoma foveata*)	In January the gangrene indexes for the 3 cultivars were lower for organic (54.0, 15.9, 23.5) than for conventional (56.7, 24.2, 23.5) potato, but there was no difference for 2 of the 3 cultivars in April. The dry core index in the cultivar 'Bintje' was lower in organic (28.6, 50.5) than conventional (23.3, 43.7) potato at both dates. For the cultivar 'King Edward' the dry core index was similar in January, but in April the organic potato (32.0) had lower dry core index than the conventional (21.9) potato. In the cultivar 'Ukama' there was no difference in dry core index between the cultivation systems at any of the dates.

Table 3. Results from included studies on apple diseases

Study	Location	Study type	System	Parameters	Key results
Borovinova Et al. 2012	Bulgaria	Field trial, 4 years	Organic, integrated and conventional, 3 cultivars	The canker fungus (*Botryosphaeria obtusa*), the white rot fungus (*Schizophyllum commune* syn. *S. alneum*)	*B. obtusa*, a wound pathogen was more severe on 3 cultivars in organic cultivation (34.8%, 15.6% and 52.4%) then on the same varieties in integrated (9.0%, 3.1%, 12,1%) and conventional cultivation (4.4%, 2.4% and 4.7%). The white rot fungus *S. commune* appeared as a secondary invader after *B. obtusa* infection.
Holb et al. 2012	Hungary	Field trial, 4 years	Experimental orchards, organic and integrated,	Apple scab (*Venturia inaequalis*) on foliage and fruits	The 4 year mean incidence of apple scab on fruit at harvest ranged from 0 to 2.4% in integrated and from 0-23.2% in organic cultivation. Mean apple scab incidence was higher in organic than in integrated cultivation systems, except for resistant cultivars, which had no apple scab on the fruits in either system.
Jönsson et al. 2010	Sweden, Skåne	Field trial, 3 years	Organic and integrated, in one orchard, 2 cultivars 'Aroma' and 'Karin Schneider'	Apple scab, brown rot (*Monilinia fructigena*) and bulls-eye rot (*Neofabrea* sp.)	Annual apple scab incidence, as measured by number of infected leaves from 4 shoots, was (5.1, 10.7 and 2.4) in 2000 on organic plots, while the figures were 0 on integrated plots. Also, in 2001 and 2002 the apple scab was more severe on organic (10%) than on integrated apples of both cultivars (<1%). In 2000 bull's eye rot was higher in organic apples of the cultivar 'Aroma' than in integrated apples of the same cultivar, while there was no difference in 'Karin Schneider'. In 2001 and 2002 organic apples of both cultivars had higher level of bull's eye rot than integrated apples. In 2 of 3 years organic apples had more brown rot than integrated apples.
Trapman et al. 2008	The Netherlands, Belgium, Germany	Sampling from orchards, 1 year	Organic and conventional	Fruit rot caused by *Botryosphaeria obtuse* syn. *Diplodia seriata*	Fruit rot appeared prior to harvest in organic apples. From a latent stage the fungus spread rapidly during storage and a firm brown rot developed. The authors did not find the rot in integrated apples, which had been sprayed in the orchard to control pathogenic fungi.
Holb 2008	Hungary	Field trial, 3 years	Organic and conventional	Brown rot, density of conidia in the air	Conidial density increased after the appearance of the first infected fruit in early July in organic and in early August in integrated

Study	Location	Study type	System	Parameters	Key results
					orchards. Final brown rot incidence reached 4.3-6.6% in integrated and 19.8-24.5% in organic orchards.
Holb et al. 2007	Hungary	Field trial, 4 years	Organic and conventional	Brown rot, fruit drop in the orchard	Epidemics started 2 to 4 weeks earlier in organic then in integrated orchards. Disease incidence was affected by cultivation system, but there was no systems-cultivar interaction.
Holb et al 2005a	The Netherlands	Sampling from 18 orchards, 2 years	Organic (9) and integrated (9) orchards	Apple scab incidence on leaves was determined before leaf fall in autumn, shoots and buds were examined for viable spores (conidia) at bud break in spring.	Apple scab incidence (<20%) in integrated cultivation was lower than in organic cultivation (>60%), and there was significant interaction between production system and orchards. In the spring there was no difference in viable conidia on shoots between the cultivation systems. The cultivation system had significant effect on viable spores associated with buds. The average number of viable spores in 100 inner buds ranged from 0 to 5.6 in 2000 and from 0 to 20.4 in 2001 in integrated orchards and from 11.3 to 110.9 in 2000 and from 5.9 to 56.5 in 2001 in organic orchards.
Holb et al. 2005b	The Nether-land and Hungary	Field trial, 4 years	Experimental orchards with organic-unsprayed, organic-sprayed and integrated	Progress of the apple scab disease on plots, separated by windbreaks (NL) and a road (H)	Apple scab epidemics started at the end of June in organic cultivation and in the end of July (H) and in early August (NL) in the integrated treatments. The disease progress was most rapid in organic-unsprayed and decreased in the order organic-sprayed and integrated. The apple fruit scab severity was generally low, extremely high values were obtained for leaf and fruit scab in the organic-unsprayed treatment.
Manici et al. 2003	Italy, South Tyrol	Field trial, 3 conventional orchard and 3 with at least 10 years organic	Organic and conventional, 3 pairs, same rootstock, same age of trees	Apple replant disease of unknown etiology. Potential pathogens and antagonists.	Organic orchards had significantly higher numbers of total soil fungi than conventional orchards, while there was no difference in the potentially pathogenic *Pythium* spp. (numbers not given). There was no difference in total culturable and in fluorescent bacteria between the cultivation systems. The apple growth score on soil samples from organic orchards (7.3) was higher than in soil samples from conventional orchards (3.8).

Table 4. Results from included studies on strawberry diseases

Study	Location	Study type	System	Parameters	Key results
Jensen et al 2013	Denmark	Farm survey	Organic and conventional	Microbiota and mycotoxins on healthy strawberries in the field	Bacteria were the most numerous microbes, followed by yeast and filamentous fungi. There was no difference between microbiota on strawberries sprayed with fungicides and organic strawberries. Mycotoxins were not detected at any of the growers
Spornberger et al. 2011	Austria, Vienna	Field experiment, 2 years	Organic and conventional	Grey mould (*Botrytis cinerea*) Verticillium wilt fungus (*Verticillium dahliae*)	In both years the grey mould rot was lowest (5%) in the conventional treatments compared to 3 different organic systems (8.0-9.4%). There was no difference in poor quality fruits due to the wilt inducing fungus.
Njoroge et al. 2009	USA, California	Field experiment, 2 years	Organic and conventional	Verticillum wilt, Pythium root rot (*Pythium* spp.)	Preplant density of Verticillum wilt was the same in both systems. Crop rotation did not reduce Pythium root rot in either system. Rotation with broccoli reduced Verticillum wilt
Rhainds et al. 2002	USA, New York State, Geneva	Field experiment, 4 years	Organic and conventional	Grey mould and control with a biocontrol fungus (*Trichoderma harzianum*) on organic plots.	Cultivation system did not affect the incidence of grey mould. Porportion of grey mould infected fruits was low and never exceeded 5%.

Table 5. Results from included studies on field vegetable diseases

Study	Location	Study type	System	Parameters	Key results
Cauliflower					
Dresbøll et al. 2008	Denmark, Aarhus	Field trial, 4 years	Organic and conventional cauliflower	Hollow stem, a nutritional disorder	More conventional cauliflower than organic cauliflower was discarded due to hollow stem. Surplus N in conventional cauliflower could explain the higher incidence of hollow stem.
Carrot					
Louarn et al. 2012	Denmark, Aarslev	Field and storage trial, 2 years	Organic and conventional carrot	Liquorice rot (*Mycocentrospora acerina*) a storage rot pathogen.	In 2007 there was no difference in liquorice rot between non- inoculated organic and conventional carrots. In 2008 non-inoculated organic carrots had more liquorice rot than conventional carrots after 6 months storage. Also after 4 months storage there was more liquorice rot in organic carrots, but the difference was not significant. In both years organic carrots inoculated with *M. acerina* developed bigger lesions than conventional carrots after 1 month of storage. There was no difference after 4 months of storage.
Dresbøll et al. 2008	Denmark, Aarhus	Field trial, 4 years	Organic and conventional carrot	Cavity spot (*Pythium* spp.)	In 2000 conventional carrots were more damaged by cavity spot than organic carrots. In 2001 there was more cavity spot in organic than in conventional carrots. The disease was absent during 2 years, and for the 4 year period there was no significant difference in cavity spot between the cultivation systems.
Westerweld et al. 20087	Canada, Ontario	Field trial, 2 years	Conventional carrot with 5 N rates: 0,	Leaf blight (*Alternaria dauci* and *Cercospora carotae)*, cavity spot	Increasing N rate decreased the severity of leaf blight. Carrots receiving 100% of recommended

Study	Location	Study type	System	Parameters	Key results
			50, 100, 150 and 200% of recommended rate.		rate had lower leaf blight severity than carrots on 0% of recommended rate. Cavity spot was not influenced by N rate.
Onion					
Galván et al. 2009	The Netherlands	Field survey, 2 years	Organic and conventional	Arbuscular mycorrhizal fungi (AMF)	Onion has a sparse root system without root hair and depend on AMF for water and nutrient uptake. Onion yield in conventional fields was positively correlated with AMF colonization level. Organic and conventional fields had similar AMF diversity.
Dresbøll et al. 2008	Denmark, Aarhus	Field trial, 3 years	Organic and conventional onion	Watery scales, a physiological disorder. Decay caused by bacteria and fungi.	There was no difference in % onions discarded due to watery scales between the cultivation systems. Also, there was no difference in decay between the cultivation systems for the three year period. During the very wet autumn of 2001 with optimum conditions for fungi and bacteria 14% of the conventional onions were discarded due to decay, while the organic onions were not affected to the same extent.
Bjom & Mette	Denmark, Tjele	Field trial	Organic and conventional onion	Downy mildew (*Peronospora destructor*)	
Tomato					
Chellemi et al. 2012	USA, Florida	Field trial, 2 years	Tomato, conventional, disk fallow, weed fallow, organic and bahiagrass (*Paspalum notatum).*	Tomato wilt (*Fusarium oxysporum*)	With organic cultivation the tomato wilt remain at < 3% during the 2 years of tomato monoculture, while in conventional cultivation the disease varied from 2 % the first year to 15 % the second year.

Study	Location	Study type	System	Parameters	Key results
Abassi et al. 2002	USA, Ohio	Field trial, 2 years	Organic and integrated tomato	Anthracnose fruit rot (*Colletotrichum cocodes*), Early blight (*Alternaria solani* and early blight /bacterial spot (*Xanthomonas* spp.)	The incidence of anthracnose fruit rot was reduced on organic plots amended with a high rate of composted cannery waste in one year with high disease incidence, while it had no effect in a year with low incidence. On conventional plots the compost treatment increased early blight and leaf spot both years, but reduced bacterial spot (*Xanthomonas* spp.) incidence on fruit in one year with high disease incidence.
Workneh et al. 1993	USA, California	Farm survey	Organic and conventional tomato	Root rot (*Phytophthora parasitica*) and corky root (*Pyrenochaeta lycopersici*)	Root rot was found on conventional farms only. Corky root was found on most farms, but the incidence and severity were higher on conventional farms. Nitrogen in tomato tissue and nitrate concentration in the soil was positively correlated with corky root severity.

6.2 Insect pests

Table 6. Results from included studies on insect pests, their natural enemies, beneficial insects (pollinators etc.) and butterflies

Study (Author, year)	Location of study	Study type	Study design				Key results
			Cultivating system (organic/ecological/ biodynamic and conventional /integrated)	*Years of study*	*Relevant parameters measured* *(insect group, abundance, species diversity etc)*	*Crop*	
Eyre et al. 2013	England	Field trials	A split conventional/organic farm.	5	Ground beetles (Carabidae) Species richness, activity	Nine arable crops, grassland	In crops, species richness was greatest in organic beans and conventional oilseed rape and lowest in conventional grass. The mean numbers recorded from crops indicated far more activity of small species in all organic crops compared with conventional, with more medium-sized species in conventional crops, especially rape. Rape and winter wheat had the most activity of large species, more than in all organic crops except spring barley.
Lohaus et al. 2013	Germany	Farm study	Ten organically managed and eight conventional fields.	4	Cereal aphid–parasitoid–hyperparasitoid communities	Winter wheat	Aphids and primary parasitoids were characterized by (1) a higher evenness of interaction frequencies in conventional fields, with (2) a higher interaction evenness, (3) a higher ratio of primary parasitoid taxa per secondary parasitoid and (4) a higher link density. Agricultural intensification appears to foster the complexity of aphid–parasitoid food webs, thereby not supporting the

Study (Author, year)	Location of study	Study type	Study design				Key results
			Cultivating system (organic/ecological/ biodynamic and conventional /integrated)	*Years of study*	*Relevant parameters measured* *(insect group, abundance, species diversity etc)*	*Crop*	
							general expectation on the importance of organic farming practices for species richness and food web complexity.
Maalouly et al. 2013	France	Farm study	122 orchards. The proportion of organic orchards increased from 17% to 50% during the five years.	5	Three species of hymenoptera parasitoids of codling moth, including two primary (Braconidae and Ichneumonidae) and one hyperparasitoid (Perilampidae) wasps.	Apple	The parasitism rates were low in all orchards each year (<4.5% in average), but they were significantly higher in organic orchards than in conventional orchards.
Schröter & Irmler 2013	Germany	Field trials	One farm, conversion from conventional to organic methods (completed after three years).	7	Ground beetles (Carabidae) Spatial and temporal changes in a population	Arable crops	At the beginning of organic farming in 2002, the abundance of nine species typical for arable fields and grassland increased, whereas the dominance of one species (*Pterostichus melanarius*) decreased.
Andersson et al. 2012	Sweden	Farm study	Twelve farms: conventionally managed (n =4), recently transformed to organic farming (‘‘new’’, 2–4 years; n= 4) or under organic management for	1	Pollination of strawberries (insects)	Strawberry	Pollination success and the proportion of fully pollinated berries were higher on organic compared to conventional farms and this difference was already evident 2–4 years after conversion to organic farming

Study (Author, year)	**Location of study**	**Study type**	**Study design**				**Key results**
			Cultivating system (organic/ecological/ biodynamic and conventional /integrated)	***Years of study***	***Relevant parameters measured*** ***(insect group, abundance, species diversity etc)***	***Crop***	
			a longer time period (''old'', 14–24 years; n= 4).				
Banfield-Zanin et al. 2012	England	Field trials	Effect of fertilisers typical of organic and conventional farming systems. Four fertiliser treatments in a fully factorial design.	2	Lady birds (Coccinellidae) Mortality of coccinellids feeding on two aphid species from *Brassica* plants	*Brassica*	Coccinellid larval mortality was 10% higher when feeding on aphids from synthetically fertilised plants compared with those in organic fertilisers, regardless of the aphid species.
Batáry et al. 2012	Germany	Farm study	Nine landscapes each with a pair of organic and conventional wheat fields and a pair of organic and conventional meadows.	1	Carnivore and non-carnivore ground beetles (Carabidae), hunter and webbuilding spiders and grasshoppers. Species richness	Winter wheat, meadows	Organic management increased grass cover in wheat fields, but not in meadows, and promoted species richness of non-carnivore carabids and hunting spiders, but not grasshoppers.
Eyre et al. 2012	England	Field trials	Conventional and organic fields in a split–split–split plot design.	4	Ground beetles (Carabidae). Activity, species richness	Arable crops	Inconsistent activity reactions to management were observed with species, size groups and feeding types. Species richness was significantly affected by crop type and where management had an influence; more species were found in organically managed plots. Ground beetle activity was influenced more by crops than by management.
Gagic et al. 2012	Germany	Farm study	Eight fields; four organically managed	1	Cereal aphids–parasitoids–	Winter wheat	Aphid–parasitoid diversity and food web structure showed greater changes

Study (Author, year)	Location of study	Study type	Study design				Key results
			Cultivating system (organic/ecological/ biodynamic and conventional /integrated)	***Years of study***	***Relevant parameters measured*** ***(insect group, abundance, species diversity etc)***	***Crop***	
			fields embedded in structurally complex landscapes and four conventionally managed fields embedded in structurally simple landscapes.		hyperparasitoids. Diversity, food web		over time in fields with high agricultural intensification, higher food web complexity, but lower parasitism rates. Both parasitism and hyperparasitism were higher in fields with low-intensity agriculture.
Gosme et al. 2012	France	Farm study	A total of 216 fields, all of the organic wheat fields in the study zone and a sample of conventional fields.	2	Aphids (Aphididae). Density	Wheat	Aphid density was significantly lower in organic fields. Aphids responded to the neighbourhood effect: the presence of organic fields in the neighbourhood decreased the number of aphids in both organic and conventional fields.
Holb et al. 2012	Hungary	Field trials	One orchard was divided into two parts: integrated and organic.	4	Codling moth (*Cydia pomonella*). Injuries were assessed on five scab-susceptible and five scab-resistant cultivars	Apple	Integrated: codling moth incidences were below 4%. All cultivars (including scab-resistant ones) were highly damaged by codling moth by harvest in the organic production system (mean incidence was above 20%).
Mates et al. 2012	Michigan, USA	Farm study	Six orchards comprised a gradient of from organic to IPM to conventional practices.	1	Hymenopteran parasitoids. Diversity and assemblage composition.	Apple	Total species richness was significantly higher in the organic orchard than in all others, but in August a conventional orchard had the highest wasp abundance and species richness.
Moschini et al. 2012	Italy	Field trials	Three agro-ecosystems, two organic of diverse	1	Predators feeding on aphids	Wheat	Coccinellidae was present in greater numbers in organic farming systems

Study (Author, year)	Location of study	Study type	Study design				Key results
			Cultivating system (organic/ecological/ biodynamic and conventional /integrated)	*Years of study*	*Relevant parameters measured* *(insect group, abundance, species diversity etc)*	*Crop*	
			age and a conventional one.		(Coccinellidae, Syrphidae and Chrysopidae). Abundance		than in conventional one and in the more complex and rich ecological infrastructure. Syrphidae and Chrysopidae may appear not suitable to highlight the effects of agro-ecosystem management.
Power et al. 2012	Ireland	Farm study	Ten pairs of organic and conventional dairy farms	1	Insect pollinated plants	Grassland	Organic field centres contained more insect-pollinated forbs than conventional field centres.
Birkhofer et al. 2011	Switzerland	Field trials	A long-term organic and conventional farming system, different sampling methods.	1	Prey and generalist predators. Predation rates	Wheat, maize	The results obtained suggest that generalist predators consumed higher proportions of herbivore prey in the organic system and that starvation and intraguild predation rates increased in some predator species with time.
Eyre & Leifert 2011	England	Farm trials	One split conventional/organic farm.	2	Beneficial invertebrate groups. Activity	Arable crops	Cantharidae, Coccinellidae, Syrphidae, Ichneumonidae, Braconidae, Proctotrupoidea and Lycosidae were more active in organic arable fields with more Staphylinidae in conventional arable crops and no obvious trend with Carabidae, Hemiptera, Neuroptera and Linyphiidae.
Kragten et al. 2011	The Netherlands	Farm study	In two sub-areas, 10 conventional and 10 organic farms were selected.	2	Invertebrates, ground-dwelling and aerial (as prey for birds).	Arable crops	Total abundance of ground-dwelling invertebrates did not differ between organic and conventional sites, but positive effects were found for several

Study (Author, year)	Location of study	Study type	Study design				Key results
			Cultivating system (organic/ecological/ biodynamic and conventional /integrated)	*Years of study*	*Relevant parameters measured* *(insect group, abundance, species diversity etc)*	*Crop*	
					Abundance		individual taxonomic groups, such as carabid beetles and spiders. On organic farms, invertebrate abundance was higher in carrots, cereals and onions compared to other crops; on conventional farms this was true for onions. On organic farms, aerial invertebrate abundance was approximately 70% higher than on conventional farms.
Krauss et al. 2011	Germany	Farm study	Thirty fields (15 organic vs. 15 conventional).	1	Pollinators, aphids and their predators. Abundance, species richness	Triticale	Organic fields had about twenty times higher pollinator species richness compared to conventional fields. Abundance of pollinators was even more than one-hundred times higher on organic fields. In contrast, the abundance of cereal aphids was five times lower in organic fields, while predator abundances were three times higher and predator-prey ratios twenty times higher in organic fields, indicating a significantly higher potential for biological pest control in organic fields.
Mikula et al. 2011	Czech Republic	Field trials	Four fields of both organic and conventional farming.	2	Soil invertebrates. Abundance, activity	Winter wheat, winter oilseed rape	The most favourable conditions for beetles were found the first year in the organic fields, the second year in the conventional fields. Spiders (Aranea)

Study (Author, year)	Location of study	Study type	Study design				Key results
			Cultivating system (organic/ecological/ biodynamic and conventional /integrated)	*Years of study*	*Relevant parameters measured* *(insect group, abundance, species diversity etc)*	*Crop*	
							did not differ in abundance in the organic and conventionally farmed winter wheat; they were significantly more abundant in organic winter rape than in the conventional crop in both years. There were no differences in the numbers of centipedes (Chilopoda) in the differently farmed fields. The distributions of the millipedes and dipterous larvae were similar in the organic and conventional crops.
Ponce et al. 2011	Spain	Farm study	Twenty-eight pairs of organic and conventional fields.	1	Weeds, arthropods. Abundance, diversity, biomass	Cereals	Organic fields showed higher abundance of weeds and arthropods (3.01 and 1.43 times, respectively). Arthropod diversity was lower in organic fields due to the presence of three dominant groups: Collembola, Chloropidae (Diptera), and Aphididae (Hemiptera). Total arthropod biomass was slightly higher in organic fields, and was affected by weed abundance and diversity.
Power & Stout 2011	Ireland	Farm study	Ten pairs of organic and conventional dairy farms. Grassland		Bees (Apidae) and hoverflies (Syrphidae). Diversity		Insect–flower interaction networks on organic farms were larger and more asymmetrically structured than networks on conventional farms. Organic farms did attract higher numbers of bees. Hoverfly evenness

Study (Author, year)	Location of study	Study type	Study design				Key results
			Cultivating system (organic/ecological/ biodynamic and conventional /integrated)	*Years of study*	*Relevant parameters measured* *(insect group, abundance, species diversity etc)*	*Crop*	
							(Shannon evenness) was greater in organic farms.
Diekötter et al. 2010	Germany	Farm study	Twelve fields (six organically and six conventionally managed).	1	Five soil arthropod taxa (ground beetles, spiders, springtails, millipedes, and woodlice). Species richness, abundance	Winter wheat	Seed predation on arable weeds was higher in organically than conventionally managed fields. Ground beetle or entomobryid springtail activity density was not affected by management type. Ground beetle species richness was on average 3 species poorer in organically managed fields in an organic landscape context than in the other systems. Spider and decomposer diversity was not significantly affected by farming system. Soil animal feeding activity and litter decomposition did not differ significantly between management types.
Ekroos et al. 2010	Finland	Farm study	The total number of fields studied was 48, with 15 in organic farms, 16 in conventional mixed farms and 17 in conventional cereal farms.	1	Arable weeds, ground beetles. Abundance, richness	Arable crops	Organic farming increased both insect-pollinated as well as overall weed species richness. Carabid species richness was mainly unaffected by farming practises although a higher alpha diversity of large and intermediate carabid species in organic and conventional mixed farms was marginally significant.

Study (Author, year)	**Location of study**	**Study type**	**Study design**				**Key results**
			Cultivating system (organic/ecological/ biodynamic and conventional /integrated)	***Years of study***	***Relevant parameters measured*** ***(insect group, abundance, species diversity etc)***	***Crop***	
							Activity-densities of carabids were highest on conventional mixed farms.
Garratt et al. 2010	England	Field trials	Effects of organic slow-release and conventional fertilizers.	2	Aphids and their natural enemies. Abundance .	Barley	Aphids were more abundant in conventionally fertilized barley but the reason for this increased abundance was species specific. Syrphid eggs were more numerous in conventionally fertilized pots, whereas the response of parasitoids appeared to be dependent on the abundance of aphids.
Holzschuh et al. 2010	Germany	Farm study	Twenty-three pairs of conventional and organic fields.	2	Cavity-nesting bees, wasps and their parasitoids. Species richness, parasitism	Wheat	The species richness of wasps and the total number of wasp brood cells were higher in organic than in conventional sites. The species richness of bees was higher in organic than in conventional sites. Parasitism rates were marginally affected by local factors.
Staley et al. 2010	England	Field trials	Organic and synthetic fertilizer treatments were applied in a randomized four block design.	2	Herbivore species. Abundance	*Brassica*	The *Brassica* specialist *Brevicoryne brassicae* was more abundant on organically fertilized plants, while the generalist *Myzus persicae* had higher populations on synthetically fertilized plants. The diamondback moth *Plutella xylostella* (a crucifer specialist) was more abundant on synthetically fertilized plants and preferred to oviposit on these plants.

Study (Author, year)	Location of study	Study type	Study design				Key results
			Cultivating system (organic/ecological/ biodynamic and conventional /integrated)	*Years of study*	*Relevant parameters measured* *(insect group, abundance, species diversity etc)*	*Crop*	
Eyre et al. 2009	England	Field trials	Effects of organic and conventional fertility and crop protection management in a split-split-split plot design.	2	Eleven groups of invertebrates, mainly predators and parasitoids. Activity	Arable crops	Crop protection applications had only a limited impact on activity. Carabidae, Lycosidae, Staphylinidae, Linyphiidae and Braconidae gave consistent responses to fertility management, with more activity of the first two groups in organic plots and more of the other three in conventional plots.
Macfadyen et al. 2009a	England	Farm study	Twenty farms (10 organic and 10 conventional.	1	Aphids. Abundance, parasitism	Mostly winter wheat, and to a lesser extent spring barley.	No difference between organic and conventional fields in the level of cereal aphid mortality due to parasitoids, the levels of primary parasitism, hyperparasitism and multiparasitism, or parasitoid diversity. There were significantly more aphids in organic cereal fields.
Macfadyen et al. 2009b	England	Farm study	Ten pairs of organic and conventional farms	2	Plants, herbivores, parasitoids.	Arable crops	Organic farms have significantly more species (plants, herbivores and parasitoids) and significantly different network structure. Herbivores on organic farms were attacked by more parasitoid species on organic farms than on conventional farms. No difference in percentage parasitism across a variety of host species was found.
Miñarro et	Spain	Field	Organic or chemical	3	Ground beetles	Apple	A change from conventional to

Study (Author, year)	Location of study	Study type	Study design				Key results
			Cultivating system (organic/ecological/ biodynamic and conventional /integrated)	*Years of study*	*Relevant parameters measured (insect group, abundance, species diversity etc)*	*Crop*	
al. 2009		trials	fertilizer, three tree-row managements (mulching, tillage or herbicide).		(Carabidae), rove beetles (Staphylinidae), ants (Formicidae) and spiders (Araneae). Activity, density		organic fertilizer treatment may be performed without differential effects on predator activity-density or biodiversity. However, a change from herbicide treatment to mulching or mechanical weed control may be significant, depending on the taxonomic group.
Veromann et al. 2009	Estonia	Farm study	One organic and one conventional field.	1	*Meligethes aeneus* (Nitidulidae) adults, larvae Abundance, larval parasitism	Winter oilseed rape	In the conventional field, significantly more *M. aeneus* adults and larvae were found than in the organic field, whereas the larval parasitism rate was significantly greater in the organic field.
Birkhofer et al. 2008a	Switzerland	Field trials	Organic and conventional plots in a Latin square design.	1	Generalist predators (Araneae, Carabidae and Staphylinidae). Abundance	Grass-clover	Organic management significantly enhanced ground-active spider numbers early and late in the growing season, with potentially positive effects of plant cover and non-pest decomposer prey. However, enhancing spider numbers in the field experiment did not improve biological control in organically managed grass–clover fields.
Birkhofer et al. 2008b	Switzerland	Field trials	Two organic and two conventional farming systems: ‘‘herbicide-free’’ bioorganic and	1	Soil fauna, aboveground fauna. Abundance	Arable crops	Spider abundance was favoured by organic management. The twofold higher abundance of this generalist predator group in organic systems

Study (Author, year)	**Location of study**	**Study type**	**Study design**				**Key results**
			Cultivating system (organic/ecological/ biodynamic and conventional /integrated)	***Years of study***	***Relevant parameters measured*** ***(insect group, abundance, species diversity etc)***	***Crop***	
			biodynamic systems and conventional systems with or without manure and herbicide application.				likely contributed to the significantly lower abundance of aboveground herbivore pests (aphids) in these systems. Other surface-active animals, whether predators (Staphylinidae and Carabidae), herbivores (herbivorous beetles) or decomposers (Entomobryidae), did not respond to farming practices.
Holzschuh et al. 2008	Germany	Farm study	Forty-two permanent field fallow strips in three regions. Twenty-one fallow strips were adjacent to organic fields and 21 were adjacent to conventional fields.	1	Bees (Apidae). Species richness	Winter wheat	An increase in organic cropping in the surrounding landscape from 5% to 20% enhanced bee species richness in fallow strips by 50%, density of solitary bees by 60% and bumble bee density by 150%. It seems likely that bees depending on nesting sites in fallow strips benefited from the more abundant flower resources provided by broadleaved weeds in organic crop fields.
Rundlöf et al. 2008	Sweden	Farm study	Twelve pairs of matched organic and conventional farms.	2	Bumble bees. Species richness and abundance	Cereals	Species richness and abundance of bumble bees were significantly positively related to both organic farming and landscape heterogeneity. However, there was an interaction effect between farming practice and landscape context so that species richness and abundance were only

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			Cultivating system (organic/ecological/ biodynamic and conventional /integrated)	***Years of study***	***Relevant parameters measured*** ***(insect group, abundance, species diversity etc)***	***Crop***	
							significantly higher on organic farms in homogeneous landscapes. The higher abundance of bumble bees on organic farms was partly related to higher flower abundance on these sites.
Clough et al. 2007a	Germany	Farm study	Forty- paired organic and conventional fields.	1	Leaf-feeding herbivores, stem-boring herbivores and their parasitoids on the creeping thistle *Cirsium arvense*. Species richness	Wheat	Herbivore species richness was enhanced by both organic farming and landscape heterogeneity but not by higher densities of thistles in the landscape. For most of the species, host-plant plots in organic fields were more likely to be colonized than those in the conventional fields.
Clough et al. 2007b	Germany	Farm study	Forty-two paired organic and conventional fields.	1	Different feeding groups of rove beetles (Staphylinidae). Activity density, species richness	Winter wheat	Management effects were found to strongly depend on feeding group. While the activity-density of predators was higher in the conventional fields, both activity-density and species richness of detritivores were higher in the organic fields. Decomposer diversity was higher in organic fields, but reached similar levels in high-yielding conventional fields.
Clough et al. 2007c	Germany	Farm study	Paired organic and conventional fields in 21 sites from three regions.	1	Plants, bees (Apidae), ground beetles (Carabidae), rove beetles	Winter wheat	α-Diversity, between-site-β-diversity of plants and bees and between-region-β--diversity of bees were higher in organic than in conventional

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			Cultivating system (organic/ecological/ biodynamic and conventional /integrated)	***Years of study***	***Relevant parameters measured*** ***(insect group, abundance, species diversity etc)***	***Crop***	
					(Staphylinidae), spiders (Araneae) Diversity		fields, providing local as well as larger-scale species richness benefits. α-Diversity did not differ between management types for the epigaeic arthropods. Lower between-site-β-diversity was found for spiders in organic fields than in conventional fields, resulting in higher total species richness in conventionally managed wheat.
Gabriel & Tscharntke 2007	Germany	Farm study	Twenty organic and 20 conventional fields.	1	Weeds (insect pollination versus non-insect pollination).	Wheat	Plant species numbers of both pollination types were much higher in organic than in conventional fields. A comparison of the proportions of both pollination types to all plant species revealed that the relative number of insect pollinated species was higher in organic than in conventional fields, whereas the relative number of non-insect pollinated species was higher in conventional fields.
Holzschuh et al. 2007	Germany	Farm study	Seven pairs of conventionally and organically cultivated fields within three regions.	1	Bees (Apidae). Diversity	Winter wheat	Higher bee diversity, flower cover and diversity of flowering plants were recorded in organic compared with conventional fields. Bee diversity was related both to flower cover and diversity of flowering plants, suggesting plant-mediated effects of

Study (Author, year)	**Location of study**	**Study type**	**Study design**				**Key results**
			Cultivating system (organic/ecological/ biodynamic and conventional /integrated)	***Years of study***	***Relevant parameters measured (insect group, abundance, species diversity etc)***	***Crop***	
							the farming system. Differences in bee diversity between organic and conventional fields increased with the proportion of arable crops in the surrounding landscape, indicating that processes at the landscape level modified the effectiveness of organic farming in promoting biodiversity.
Menalled et al. 2007	Michigan, USA	Field trials	Conventional systems vs. no-till and organic management systems, complete block design.	1	Ground beetles (Carabidae) Activity-density , diversity	Corn, soybean, winter wheat	Total carabid activity-density was over two times higher in the conventional systems compared to the no-till and organic management systems. In contrast, activity-densities of seed predating carabid species were over three times higher in the no-till compared to the conventional and organic systems. Carabid diversity was higher in the no-till and organic systems compared to the conventional system.
Öberg 2007	Sweden	Farm study	Eight organically or conventionally managed farms.	1	Spiders (Araneae). Activity density, species richness	Spring sown cereals (barley, oats, wheat)	The most dominant species of each spider family, *Pardosa agrestis* (Lycosidae) and *Oedothorax apicatus* (Linyphiidae), had higher activity density at organic sites. Linyphiid species richness was higher on conventional sites.
Ponti et al.	California,	Field	Effects of organic vs.	1	Aphids (Aphididae,	Broccoli	In compost-fertilized broccoli

Study (Author, year)	Location of study	Study type	Study design				Key results
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2007	USA	trials	synthetic fertilisers in plots (completely randomized design).		parasitoids (Aphidiidae)		systems, seasonal parasitization rates of *Brevicoryne brassicae* by *Diaeretiella rapae* increased along with the expected lower aphid pressure compared with synthetically fertilized plants.
Poveda et al. 2006	Germany	Farm study	Conventional vs. organic farming and the presence or absence of soil organisms (defaunated by freezing vs. control soil) in five landscapes.	1	Aphids (Aphididae) Abundance	Wheat	Aphid abundance was reduced by defaunation but only in organic soils. This suggests that soil organisms in organic farming systems are more important for aphid performance than in conventional systems.
Alyokhin & Atlihan 2005	Maine, USA	Field trials	Plants grown in manure-amended and synthetically fertilized soils. Randomized complete block design.	1	Colorado potato beetle, *Leptinotarsa decemlineata* (Chrysomelidae). Reproduction and development.	Potato	Female fecundity was lower in field cages set up on manure-amended plots early in the season, although it later became comparable between the treatments. Fewer larvae survived past the first instar, and development of immature stages was slowed down on manure-amended plots. In the laboratory, first instars consumed less foliage from plants grown in manure-amended soils. These results show that organic soil management is associated with plant characteristics unfavourable for beetle reproduction and development.

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			Cultivating system (organic/ecological/ biodynamic and conventional /integrated)	***Years of study***	***Relevant parameters measured*** ***(insect group, abundance, species diversity etc)***	***Crop***	
Clough et al. 2005	Germany	Farm study	Forty-two paired organic and conventional winter wheat fields.	1	Spiders (Araneae). Activity density, diversity	Winter wheat	No differences in activity density and diversity were found between organic and conventional fields.
Koss et al. 2005	Washington, USA	Farm study	Thirty-one fields: conventional fields treated with broad-spectrum insecticides, conventional fields treated with selective insecticides, and organic fields treated with insecticides certified for organic production.	2	Arthropods: pests and predators. Density	Potato	While predator densities were generally high in organic fields, these fields also had the highest densities of the two most injurious insect pests, the green peach aphid (*Myzus persicae*) and the Colorado potato beetle (*Leptinotarsa decemlineata*).
Purtauf et al. 2005	Germany	Farm study	Twelve pairs of organic versus conventional wheat fields located along a gradient of landscape complexity.	1	Ground beetles (Carabidae). Density, species richness	Winter wheat	Organic and conventional management did not differ with respect to species richness and activity density. Seven species were more abundant under organic management, and eight species were more abundant under conventional management.
Roschewitz et al. 2005	Germany	Farm study	Twenty-four paired winter wheat fields (i.e., one organic and one conventional field close to each other).	3	Aphids (Aphididae). Density, parasitism	Winter wheat	Organic farming was related to lower abundance of cereal aphids at the time of wheat flowering, but not to higher parasitism. At wheat ripening, complex landscapes were related to higher parasitism than simple landscapes, presumably due to more overwintering sites, alternative hosts

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							and nectar sources for parasitoids.
Schmidt et al. 2005	Germany	Farm study	Twelve pairs of organic vs. conventional fields along a gradient of landscape complexity.	1	Ground-dwelling spiders (Araneae). Abundance, density	Winter wheat	Organic agriculture did not increase the number of spider species, but enhanced spider density by 62%. Additionally, spider density was positively related to the percentage of non-crop habitats in the surrounding landscape, but only in conventional fields.
Ngouajio & McGiffen Jr. 2004	California, USA	Field trials	Organic, integrated, conventional, split-plot design.	2	Cabbage looper (*Trichoplusia ni*). Abundance	Lettuce	Lettuce management system significantly affected cabbage looper populations. The organic system had high insect populations throughout the growing season compared with the two other management systems.
Ôstman et al. 2003	Sweden	Farm study	Five conventional and five organic farms.	1	Aphids (Aphididae), ground-living natural enemies of the bird cherry-oat aphid (*Rhopalosiphum padi*). Yield	Spring barley	On average, ground-living natural enemies of pests increased barley yields by 303 kg/ha. The increase in yields in absolute terms was larger on conventional farms than organic farms, but the percentage increase of yields was larger on organic farms.
Pfiffner & Luka 2003	Switzerland	Farm study	Twelve farms. Each low-input integrated crop management field was paired with an organic or bio-dynamic field.	3	Ground beetles (Carabidae), epigeal spiders (Araneae). Abundance, species richness	Winter cereals	In several cases, carabid populations of organic fields were significantly richer in species and abundance than in the low-input integrated crop management farmed plots.

Study (Author, year)	**Location of study**	**Study type**	**Study design**				**Key results**
			Cultivating system (organic/ecological/ biodynamic and conventional /integrated)	***Years of study***	***Relevant parameters measured*** ***(insect group, abundance, species diversity etc)***	***Crop***	
							Endangered, stenoceous carabids (e.g. xero-thermophilous) and top-predators were more abundant in the organic fields. Wolfspiders (Lycosids) such as *Pardosa agrestis*, *P. palustris* and *Trochosa ruricola* seem to be enhanced by organic management. Linyphiids (*Erigone atra*, *Oedothorax apicatus*) were more abundant in low-input integrated crop management fields. Several carabid species and wolfspiders which have their main distribution in semi-natural habitats occurred more abundant in organic fields.
Schmidt et al. 2003	Germany	Field trials	Plots in two organic and in two conventional fields.	1	Aphids (Aphididae), parasitism (Aphidiidae).	Winter wheat	No differences in parasitism between conventional and organic management were found.
Weibull & Östman 2003	Sweden	Farm study	Eight conventional and eight organic farms.	3	Butterflies, ground beetles (Carabidae). Species composition	Cereal fields, leys, and semi-natural pastures	Habitat type explained most of the variation in species composition of butterflies and ground beetles. Farm management explained some additional variation in species composition of carabids and butterflies, but it was of minor importance compared to landscape features for species composition.
Weibull et	Sweden	Farm	Sixteen farms divided	3	Butterflies, ground	Cereal fields,	There were no differences in species

Study (Author, year)	Location of study	Study type	Study design				Key results
			Cultivating system (organic/ecological/ biodynamic and conventional /integrated)	***Years of study***	***Relevant parameters measured (insect group, abundance, species diversity etc)***	***Crop***	
al. 2003		study	into eight pairs of one conventional and one organic farm.		beetles (Carabidae), rove beetles (Staphylinidae), spiders (Araneae). Species richness	leys (grass and clover crop) and semi-natural pastures	richness between the farming systems, except for carabids that had higher numbers of species on conventional farms.
Hummel et al. 2002	North Carolina, USA	Field trials	A split-plot design. Conventional (continuous tomato) vs. biological (3-year rotation of corn, cucumber and tomato).	4	Insect pests. Abundance	Tomato	Thrips (*Frankliniella* spp. (Thysanoptera)) populations were significantly higher in the biological input treatments in 3 of 4 years. Lepidopterous (primarily *Helicoverpa zea* (Lepidoptera: Noctuidae)) damage on tomato was significantly higher in biological treatments in all years.
O'Sullivan & Gormally 2002	Ireland	Farm study	One conventional and one organic field.	1	Ground beetles (Carabidae). Abundance, species richness, diversity	Potato	Overall more than four times as many carabids were captured at the organic site than at the conventional site, and abundance was consistently greater at the organic site for each sampling date. On the other hand, overall carabid species richness was the same at both sites although it was also consistently greater at the organic site for each sampling date. In addition, the diversity index was greater at the organic site than at the conventional site.
Rhainds et al. 2002	New York, USA	Field trials	Organic vs. conventional in a split-split-plot	4	Tarnished plant bugs *(Lygus*	Strawberry	Density of nymphs and proportion of fruits damaged by plant bugs were

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			design.		*lineolaris)*, slugs. Abundance, fruit damage		higher in organic than in conventional plots. In contrast, management system and strawberry cultivar did not affect to a great extent the incidence of damage by grey mould or slugs.
Alvarez et al. 2001	England	Farm study	Twenty-four fields (organic, integrated and conventional).	1	Epigeic Collembola. Abundance, number of species, and several different indices of diversity	Winter wheat	Few differences between the farming regimes were significant. *Entomobrya multifasciata* and *Isotomurus* spp. were consistently, although not significantly more common in conventional than organic fields whereas the opposite was true for *Isotoma viridis* and *Isotoma notabilis*. Organically and conventionally farmed fields were found not to differ significantly from each other in community composition.
Letourneau & Goldstein 2001	California USA	Farm study	Nine organic and nine conventional farms.	1	Arthropods. Pest damage levels, abundance, species richness	Tomato	Conventional and organic farms shared a similar range of arthropod damage levels to tomato. Whereas herbivore abundance did not differ, higher natural enemy abundance and greater species richness of all functional groups of arthropods (herbivores, predators, parasitoids and other) distinguished organic from conventional tomato.
Östman et	Sweden	Farm	Five farms were managed	2	The bird cherry-oat	Spring	Natural enemies had a greater impact

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			Cultivating system (organic/ecological/ biodynamic and conventional /integrated)	*Years of study*	*Relevant parameters measured* *(insect group, abundance, species diversity etc)*	*Crop*	
al. 2001		study	organically and five were managed conventionally.		aphid (*Rhopalosiphum padi*) (Aphididae). Aphid establishment, predation.	barley	on *R. padi* establishment on organic farms than on conventional farms.
Andersen & Eltun 2000	Norway	Farm study	Two farms during the conversion from conventional to organic farming.	6-8	Ground beetles (Carabidae), rove beetles (Staphylinidae). Activity density, diversity	Arable crops	A positive effect of organic farming on carabids and a negative effect on staphylinids were identified even at the species level.
Miliczky et al. 2000	Washington, USA	Farm study	Nine orchards were studied, three orchards where the farmers used mating disruption against codling moth, three conventional and three certified organic orchards.	3	Spiders (Araneae). Abundance, diversity	Apple	Total arboreal spider density and total understory vegetation spider density were significantly higher in organic orchards than in orchards with mating disruption and in conventional orchards.
Clark 1999	California. USA	Field trials	Four organic and four conventional farming system plots.	1	Ground beetle (Carabidae) Abundance	Tomato	Abundance and species richness were greater in the organic system compared to the conventional system. Six of the 17 species collected were found only in organically managed plots. However, no differences in

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			Cultivating system (organic/ecological/ biodynamic and conventional /integrated)	***Years of study***	***Relevant parameters measured*** ***(insect group, abundance, species diversity etc)***	***Crop***	
							species diversity or evenness were found.
Feber et al. 1997	England	Farm study	Eight pairs or ten of organic and conventional farms.	2	Butterflies. Abundance	Arable crops	Total butterfly abundance was significantly higher on organic farms than on conventional farms in both years and significantly more non-pest butterflies were recorded on organic than on conventional farmland. By contrast, there was no significant difference in either year in the abundance of two pest species, *Pieris brassicae* and *Pieris rapae* between the two systems.
Reddersen 1997	Denmark	Farm study	Twenty-one and 17 matched pairs of organic and conventional cereal fields.	2	Arthropods. Species diversity, abundance	Cereals	Excluding aphids and Collembola, total density, species diversity, total biomass and number of bird food items were consistently and often significantly higher in organic than conventional cereal fields. This was also the case with a number of single arthropod orders, families and species.
Moreby 1996	England	Farm study	Organically vs. conventionally managed farms (56 and 62 fields).	2	Plant bugs (Heteroptera). Species diversity, density	Winter wheat	In both years, higher densities in four out of five of the heteropteran groups (total Heteroptera, predatory species, Stenodemini and total “other” species), were found in the organically farmed fields compared to conventionally farmed ones. However,

Study (Author, year)	Location of study	Study type	Study design				Key results
			Cultivating system (organic/ecological/ biodynamic and conventional /integrated)	*Years of study*	*Relevant parameters measured* *(insect group, abundance, species diversity etc)*	*Crop*	
							only the densities of total "other" species proved to be significantly different between treatments and only in one year. While this combined group contains over 20 taxa (genera or species), no significant differences in the number of species occurred between treatments.
Pfiffner & Niggli 1996	Switzerland	Field trials	Bio-dynamically, organically and conventionally cultivated plots in a randomized block design.	3	Ground beetles (Carabiddae), rove beetles (Staphylinidae), spiders (Araneae). Abundance, activity-density	Winter wheat	Compared with the conventional plots (= 100%), the bio-dynamic plots contained 193% of epigeic arthropods, the organic plots 188%. The activity-density of carabids, staphylinids and spiders was higher in the bio-dynamic and the organic than in the conventional plots inn all three years. In two out of three years, the difference between the conventional and the bio-dynamic, organic plots was significant.
Drinkwater et al. 1995	California, USA	Farm study	Twenty farms, organic and conventional.	2	Arthropods. Pest damage, abundance, species richness	Tomato	Herbivore damage on tomato foliage and fruit in organic and conventional fields did not differ significantly. The abundance of arthropod herbivores was similar in organic and conventional farms. Species richness of predators and parasitoids was > 75% greater on average, and natural

Study (Author, year)	Location of study	Study type	Study design				Key results
			Cultivating system (organic/ecological/ biodynamic and conventional /integrated)	*Years of study*	*Relevant parameters measured* *(insect group, abundance, species diversity etc)*	*Crop*	
							enemies were 80% more abundant, on organic farms than on conventional farms.
Knight 1994	Washington, USA	Farm study	Five paired certified organic and conventional orchards.	1	Insect pests and natural enemies. Density, fruit injury	Apple	Organic orchards had significantly higher populations of sucking bugs at bloom than did conventional orchards. There was no significant difference between orchard types in the densities of rosy apple aphid colonies per tree, but colonies in conventional orchards had significantly more aphids and significantly less parasitism than in organic orchards. The population density of green aphids was higher in conventional than organic orchards during the second half of the season. There was little difference in numbers of adult leafhoppers between orchard types, but captures of a leafhopper egg parasite were significantly higher in organic than in conventional orchards throughout the season. Immature leafminer populations were significantly higher and parasitism of leaf miner was significantly lower in conventional than organic orchards after July.
Moreby et	England	Farm	Three organically and	2	Arthropods.	Winter	Significantly higher densities of

Study (Author, year)	Location of study	Study type	Study design				Key results
			Cultivating system (organic/ecological/ biodynamic and conventional /integrated)	*Years of study*	*Relevant parameters measured* *(insect group, abundance, species diversity etc)*	*Crop*	
al. 1994		study	five conventionally grown farms.		Density	wheat	nematoceran and acalypteran Diptera, Hemiptera (especially aphids), aphid-specific predators, parasitic Hymenoptera and cryptophagid and cantharid Coleoptera were found in conventionally grown fields. Significantly higher densities of weevils, spiders, springtails, plant hoppers and sawfly larvae were found in organic fields.
Booij & Noorlander 1992	The Netherlands	Farm study	Conventional, integrated and organic systems (20 ha each) on one farm.	3	Epigeic predators. Species density, abundance	Wheat, pea, sugar beet, potato, onion and carrot	Predator abundance within each crop is increased by integrated and organic farming practices but only minor effects were found on species diversity. In most cases the type of crop appeared to be of greater importance. Within each crop, integrated and organic farming appears to stimulate carabid abundance. Spiders significantly benefit from integrated and organic farming but this is not clear for the staphylinids. Average species density is somewhat higher in integrated and organic systems. For the linyphiid spiders both system and crop effects on species density are insignificant.

6.3 WEEDS

Table 7. Results from included studies on Weeds

Study	Location of study	Study type	Study design			Key results
			Explanatory variable («x»)	Response variable («y»)	Statistical analysis	
Agha, J. M. and B. Pallutt, 2006	Germany (south?)	Field Since 1995 / «long term» conversion	Cereal cropping syst.: - Integrated 50% reduced herbicide rate (than…) - Situation related dosage - Organic - year / time	-Weed population dynamics -Species composition		organic farming: -Changes in weed density and species composition of weeds occurred only after approx. 5 years. -Increase of Cirsium arvense and Vicia hirsuta (tofrøvikke) was observed. -The diversity of weed species in the organic farming system was higher compared with the continuous treatment with a 50 percent reduced herbicide dosage.
Albrecht, H., 2005	Germany (south)	Field (farm) 2 years before and 6 years after conversion (to organic)	Rotation: 1.grass-cover, 2.winter wheat, 3.winter rye, 4.white lupin (repl. green fallow)*, 5.winter wheat, 6.potatoes, 7.sunflower (*3. year) Winter cereals undersown (spring) Weakness: Management within each crop: VERY poorly described!	-Weed seed bank	Non-parametric methods Principal componenet analysis (PCA)	First 3 years after conversion vs. seedbank: -increased from 4050 to 17 320 m^{-2}. -fourth to sixth yr, dropped to 10 220 m^{-2}. -increased at sites with a low crop cover and a high density of weed plants at the soil surface. Crops vs. seedbank -30-40% incr: winter cereals/sunflow./lupins. -no change: Potatoes and sown fallow (?) -minus 39%: grass-clover mix. Weed species -31 sp. Increased, 3 decreased -increase: summer annual+perennials+dicots -causes: repl. Herbicide by mechanical man. -causes2: increase broad leaved+spring sown -favours plant spp. Diversity -conversion=no dominance of some species

Study	Location of study	Study type	Study design: Explanatory variable («x»)	Study design: Response variable («y»)	Study design: Statistical analysis	Key results
Armengot, L., et al., 2013	Spain Catalonia	Field	Winter wheat or barley <u>Each location:</u> Conv. Vs. organic (neighbours) -1non-weed plot -2a weed control Herbicides (conv.)* or. -2b weed control Harrow (organic)* -3 Weed free plots (hand weeded) *Farmers normal practise 11 locations = 22 farms!	-Cereal biomass -weed density -weed biomass -weed cover -species richness Cereal biomass: 4 x (0,25cm x 0,25cm) squares Very small!	Shannon's diversity index Mixed models	See table A below
	<u>Organic vs. conventional:</u> weed harrowing avoided yield decrease. Also use of herbicides avoided yield decrease Conv.: Non-weed vs. weeded = -11.4% yield (between 0% and 21.1%) (see Table) Organic: Non-weed vs. weeded = -15.24% yield (between 0% and 43.5%) (see Table) Harrowing: did <u>not affected</u> weed species richness Herbicides: did <u>affected</u> weed species richness.					
Armengot, L., et al., 2012	Spain Catalonia and north Germany	Survey	Locations: Spain and Germany Farming system: Conv. Vs. Organic 26 farms	*-Beta-diversity* *-species richness*	Mixed models Lme4 package	See table B below

Key results A (Armengot, L., et al., 2013):

	<u>Control*</u>	<u>ORG</u>	<u>CONV</u>	<u>Weed free</u>
Yield	-	77**	100	-
Yield 2	88.6	-	100	-
Yield 3	84.76	100	-	-
Weed cover	100	-26,7%	-75,5%	-
Weed density	100	-54% (130)	-64,7% (100)	-
Weed biomass	100	-51,8% (173)	-72,15% (100)	-

*Not weeded plots **minus 23% crop yield (probably because of fertilization)

Key results B (Armengot, L., et al., 2012):

	<u>ORG.</u>	<u>CONV.</u>
Spain: Species richness	69.8%	35.5%
Germany: Species richness	62.4%	53%

<table>
<tr><th rowspan="2">Study</th><th rowspan="2">Location of study</th><th rowspan="2">Study type</th><th colspan="3">Study design</th><th rowspan="2">Key results</th></tr>
<tr><th>Explanatory variable («x»)</th><th>Response variable («y»)</th><th>Statistical analysis</th></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td>Importance of organic farming for arable weed species richness.</td></tr>
<tr><td>Barbas, P. and B. Sawicka, 2010</td><td>Poland</td><td>Field</td><td>Potatoes

Conv. Vs. organic

(direct and indirect methods appropriate for both systems)</td><td>-Weed infestation</td><td></td><td><table><tr><td></td><td>ORG.</td><td>CONV.</td></tr><tr><td>Weed number</td><td>higher</td><td></td></tr><tr><td>Weed biomass</td><td>higher</td><td></td></tr></table>Important to use optimal cv.'s: Stalk types and with resistance to Phytophtora infestans</td></tr>
<tr><td>Davis, A. S., et al., 2005</td><td>USA</td><td>Field

1990-2002</td><td>Corn-soybean-wheat crop sequence

4 Systems:
-CONV (Nfull-Herbic-Plough)
-NT (same as CONV but NT)
-RI (Nred-Herbicide red-Plough-mech weed control-red cl. Undersown in wheat)
-ORG (same as RI but no synthetic input)</td><td>-Weed seedbank
-Aboverground biomass
-Shannon diversity index
-Crop yield</td><td>Multi-variate analysis
ANOVA / GLM</td><td>CONV and NT seedbanks: dominated by grass species (mainly fall panicum (and large crabgrass),

RI and ORG: dominated by common lambsquarters (Chenopodium album) and common chickweed (Stellaria Media).

Within a single growing season, weed seedbanks in the RI and ORG systems were positively correlated with weed biomass whereas seedbanks in the CONV and NT system had little predictive value.</td></tr>
<tr><td>Dorner, Z., et al., 2004</td><td>Hungary</td><td>Farm Survey</td><td>Cereals

- intensive, chemical-treated
- extensive, non-chemical methods*

(incl. old organic fields with</td><td>-Weed density</td><td></td><td>-Higher weed diversity can be observed in fields where no chemical and mechanical weed control,
and in addition no stubble breaking is performed.

-Rare weed species can be found in the field and in the field margins.</td></tr>
</table>

<table>
<tr><th rowspan="2">Study</th><th rowspan="2">Location of study</th><th rowspan="2">Study type</th><th colspan="3">Study design</th><th rowspan="2">Key results</th></tr>
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<tr><td></td><td></td><td></td><td>mech. weed control)</td><td></td><td></td><td>-On the area which has been under ecological farming for 15 years and where mechanical weed control is done (e. g. weed harrow) the number of weed species is low.

-There is almost no difference in the composition of weed species compared to the adjacent, conventionally managed areas.

-With the usage of herbicides weed flora gets poorer,but cultivation itself has an even greater impact on it.</td></tr>
<tr><td>Duer, I. and B. Feledyn-Szewczyk, 2001</td><td>Poland</td><td>Field

Long term 1996-1999</td><td>Spring barley

<u>Cropping systems:</u>
-Organic (=no treatments because of undersown clover)

-integrated (=standard cultivation + herbicides)

-conventionally (=herbicides)</td><td>-Cereal biomass

-weed density
-weed biomass
(+”species richness”, =species number)</td><td></td><td><table><tr><th></th><th><u>ORG.</u></th><th><u>INTEGR.</u></th><th><u>CONV.</u></th></tr><tr><td>Spring barley yield averaged</td><td>3.61 (71%)</td><td>4.72 (93%)</td><td>5.07 (100%)</td></tr></table>-Less difference between systems in number of weed species than in number of individuals after 4 years of research.

-Among species, Chenopodium album, Viola arvensis, Galium aparine, Capsella bursa-pastoris and Stellaria media were common and dominated independently of cropping system.

Quantitative changes in weed infestation depended on efficiency of weed control methods.

-The largest number of weed species and biomass was observed on the field with spring barley in the organic systems.</td></tr>
</table>

<table>
<tr><th rowspan="2">Study</th><th rowspan="2">Location of study</th><th rowspan="2">Study type</th><th colspan="3">Study design</th><th rowspan="2">Key results</th></tr>
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<tr><td>Duer, I. and B. Feledyn-Szewczyk, 2001</td><td>Poland</td><td>Field

Long term 1996-1999</td><td>Spring barley

<u>Cropping systems:</u>
-Organic (=no treatments because of undersown clover)

-integrated (=standard cultivation + herbicides)

-conventionally (=herbicides)</td><td>-Cereal biomass
-weed density
-weed biomass
-weed cover
-species richness</td><td></td><td>Organic:
Weed density, diversity and biomass were largest
Weed seed number in the soil depth 0-20 cm was largest

Organic + Integrated:
Galium aparine, Stellaria media and Chenopodium album most common

All systems:
Viola arvensis was the predominant species in all three systems

Integrated:
most effective both in reduction of weed density and the soil seed bank

Conventional:
Capsella bursa-pastoris (“was common”)</td></tr>
<tr><td>Edesi, L., et al. 2012.</td><td>Lithuania</td><td>Field</td><td>Rotation: Potato – oat - barley w/undersown red clover - red clover – winter rye

<u>Cropping systems:</u>

-Organic ORGFYM (green and cattle manure)

-Organic ORGGRM (green manure)

-Conventional CONFYM (green manure, cattle manure, mineral</td><td>-weed density
-weed biomass
-Weed species (richness)

(not crop yield!)</td><td></td><td><table>
<tr><td></td><td><u>ORGFYM</u></td><td><u>ORGGRM</u></td><td><u>CONFYM</u></td></tr>
<tr><td>the number of weed species</td><td>36
(21+1+14)
120</td><td>39*
(24+0+15)*
130</td><td>30
(19+1+10)
100</td></tr>
<tr><td>Species (per 0.25 m^2)</td><td>9.3
190</td><td>9.2
188</td><td>4.9
100</td></tr>
<tr><td>Shannon diversity index</td><td>1.65b</td><td>1.70b</td><td>1.06a</td></tr>
<tr><td>Most common</td><td colspan="3">Among the perennials E. repens was the most common species in all treatments.</td></tr>
</table></td></tr>
</table>

Study	Location of study	Study type	Study design			Key results
			Explanatory variable («x»)	Response variable («y»)	Statistical analysis	
			fertilizer, pesticides) Organic areas (certified?) Mouldboard ploughing 20 cm Oats; barley ;rye: Spring tine harrowing (not specied 1x or 2 x) Potato: cultivated 3x.			The highest number of these plants occurred in the ORGGRM treatment. Total 44 weed species/taxa were encountered during the study covering a period of 2007-2011. (In parentheses : annuals + biennials + perennials) **Centaurea cyanus, Cerastium arvense, Geranium pratense, Myosurus minimus, Polygonum laphatifolia, Plantago lanceolata* and *Plantago major* were found only in ORGGRM treatment.
	Chenopodium album was the most common annual species in all treatments. They found that herbicide application in the CONFYM treatment decreased the density of the most sensitive species (e.g., C. album, Polygonum convolvulus, Mentha arvensis, Polygonum persicaria, Elytrigia repens) but had a minor or no effect on the proportion of herbicide-tolerant species (especially Viola arvensis, Veronica spp., Myosotis arvensis). The species pool was larger and the average number of species higher in the organic than in the conventional treatment. No significant difference was identified between the organic treatments “Our results suggest that weed species diversity could be promoted by using organic cropping practices”.					
Ekroos, J., et al. 2010.	Finland	Survey	<u>Cropping system:</u> 1.Organic 2.Conv. cereal farming 3.Conv. mixed farming	arable weeds and carabid beetles - distribution of ecological traits, -diversity partitions, - -species richness and abundance		Organic farming increased both insect-pollinated as well as overall weed species richness, whereas the proportion of insect-pollinated weed species of the total species richness was unaffected by farming practises. Carabid species richness was mainly unaffected by farming practises although a higher alpha diversity of large and intermediate carabid species in organic and

Study	Location of study	Study type	Study design: Explanatory variable («x»)	Study design: Response variable («y»)	Study design: Statistical analysis	Key results
						conventional mixed farms was marginally significant. It is concluded that arable weed diversity is affected by organic farming to a higher extent than carabids.
Eyre, M. D., et al. 2011		Survey (128 plots)	<u>Conventional rotation:</u> 1. Grass/clover ley,2. Grass/clover ley, 3.winter wheat, 4.winter wheat, 5.winter barley, 6.potatoes /vegetables, 7. Winter wheat, 8.winter barley. <u>Organic rotation:</u> 1.Grass/clover ley, 2. Grass/clover ley, 3. Grass/clover ley, 4.winter wheat, 5.potatoes /vegetables, 6.springbeans, 7. potatoes /vegetables, 8.spring barley Then combined with conventional or organic CROP PROTECTION (mean plots) and the combined with conventional or organic FERTILITY. -Effect of the 2008 crop -Two preceding crops -Organic and conventional: 1. crop protection 2. fertility management Organic protection: not very good explained, just described as	<u>Cover data for 22 weed species</u> and for -monocotyledon, -dicotyledon, -annual, -perennial, and -total weed cover were used		Cover of 15 weed species, and of the five weed groups, was significantly affected by 2008 crops, with cover highest in spring beans and cabbage. Nine and four weed species 2008 cover were significantly related to crops grown in 2007 and 2006 respectively, as were dicotyledon, annual and total weed cover, but not monocotyledon or perennial cover. Cover of 15 species (of 22), and the five groups, was significantly higher in plots with organic crop protection, but only eight species and annuals were significantly affected by fertility management. Crop Protection (13 of 22 higher in organic vs. conv.)

<u>Species</u>	<u>Organic</u>	<u>Convent.</u>	<u>Per cent*</u>
Capsella bursa-pastoris	0.8	0,2	+300
Chenopodium album	0.9	0.5	+80
Cirsium arvense	0,9	0,5	+80
Fumaria officinalis	1,8	0,8	+125
Galium aparine	0,7	0,2	+250
Poa annua	3,6	1,3	+177
Polygonum aviculare	2	1	+100

Study	Location of study	Study type	Study design			Key results			
			Explanatory variable («x»)	Response variable («y»)	Statistical analysis				
			those methods permitted in organic. Examples given! Conventional: pesticides etc.			Rumex crispus	1,6	0,8	+100
						Senecio vulgaris	2,4	1,1	+118
						Sinapis arvensis	1,9	0,4	+375
						Stellaria media	2,2	1,1	+100
						Taraxacum officinale	0,9	0,6	+50
						Trifolium repens	0,7	0,6	+17
						Monocoyledons	6,6	4,2	+57
						Dicotyledons	21,8	11,4	+91
						Annuals	15,8	7,3	+116
						Perennials	12,6	8,3	+52
						Total weeds	**28,4**	**15,6**	**+82**
						Fertility (organic vs. conventional)			
						Species	Organic	Convent.	%
						Atriplix patula	0,4	0,3	+33
						Cirsium arvense	1,0	0,4	+150
						Cirsium vulgare	1,3	0,5	+160
						Lolium perenne	2,8	2,3	+22

Study	Location of study	Study type	Study design: Explanatory variable («x»)	Study design: Response variable («y»)	Study design: Statistical analysis	Key results			
						Rumex obtusifolius	0,4	0,8	-50
						Sinapis arvensis	0,9	1,5	-60
						Stellaria media	1,1	2,2	-50
						Trifolium repens	0,9	0,4	+125
						Monocoyledons	5,9	4,9	+20
						Dicotyledons	16,4	16,8	-2
						Annuals	10,7	12,4	-14
						Perennials	11,6	9,3	+25
						Total weeds	22,3	21,7	+3
Feledyn-Szewczyk, B. 2012	Poland	Field exp. 2008-2010	Spring wheat. Weed control methods. Cropping systems: -Integrated -Conventional -Organic A part of a long term exp. Started in 1994. Conventional and integrated systems, spring wheat pure stand. Conventional system: herbicides	-Weed number -Weed biomass -Yield		In the conventional and integrated systems, compensation of some weed species was observed (Viola arvensis, Fallopia convolvulus, Equisetum arvense). The comparison of weed communities using Sorenson's indices revealed more of a similarity between systems in terms of number of weed species than in the number of individuals. Such results imply that qualitative changes are slower than quantitative ones.			
							Org.	Integrated	Conv.
						Weed biomass gm^{-2}	60 (+900)	15 (+150)	6 (100)

Study	Location of study	Study type	Study design: Explanatory variable («x»)	Study design: Response variable («y»)	Study design: Statistical analysis	Key results			
			were applied two times in a growing season. Integrated system - only once. Organic system: wheat with undersown clover and grasses. Organic: Not harrowed			Weed diversity	highest	Compensation of some weed species was observed (Viola arvensis, Fallopia convolvulus, Equisetum arvense)	
						Yield	4074 kg ha^{-1}	5500 kg ha^{-1}	4583 kg ha^{-1}
						Yield, rel.1	89 (-11)	120	**100**
						Yield, rel.2	74 (-26)	**100**	83
Feledyn-Szewczyk, B. and I. Duer 2006 A	Poland	Field exp. 1999-2001	WINTER WHEAT Weed control methods. <u>Cropping systems:</u> -Integrated -Conventional -Organic A part of a long term exp. Started in 1994.	-weed species composition, -number of weed individuals -weed dry matter analysis -comparison of weed communities using ecological indices. Shannon's diversity index (H'), Simpson's dominance index (SI) and Sorenson's indices of similarity were used in the study	*One exp.* *3 year*		<u>Organic</u>	<u>Integrated</u>	<u>Conv.</u>
						Weed diversity	highest		
						Shannon's Diversity index	highest		
						Simpson's Dominance index			Largest (and Mono-culture)
						The comparison of weeds in winter wheat cultivated in different crop production systems using Sorenson's indices revealed bigger similarity between systems in terms of number of weed species than in number of individuals, which implies that the qualitative changes are slower than the quantitative ones.			

<table>
<tr><th rowspan="2">Study</th><th rowspan="2">Location of study</th><th rowspan="2">Study type</th><th colspan="3">Study design</th><th colspan="5" rowspan="2">Key results</th></tr>
<tr><th>Explanatory variable («x»)</th><th>Response variable («y»)</th><th>Statistical analysis</th></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td colspan="5"></td></tr>
<tr><td rowspan="7">Feledyn-Szewczyk, B. and I. Duer, 2006 B</td><td rowspan="7">Poland</td><td rowspan="7">Field exp.

2002-2004</td><td rowspan="7">Spring barley
<u>Cropping systems:</u>
-Integrated
-Conventional
-Organic
-Monoculture

Conventional and integrated systems, spring barley pure stand.

Organic barley undersown with white clover and Lucerne

In the conventional system, weeds were controlled by herbicides, whereas in the integrated system, mechanical weed control was supplemented by moderate herbicide use.</td><td rowspan="7">Weed density
Weed biomass
Yield</td><td rowspan="7">One exp.
3 year</td><td></td><td><u>Organic</u></td><td><u>Conv.</u></td><td colspan="2"><u>Integrated</u></td></tr>
<tr><td>Weed diversity</td><td>highest</td><td></td><td colspan="2"></td></tr>
<tr><td>Weed number (per m2)</td><td>Highest
105</td><td>?</td><td colspan="2">?</td></tr>
<tr><td>Weed dry matter (g per m2)</td><td>Highest
23</td><td></td><td colspan="2"></td></tr>
<tr><td>Dominating</td><td>Chenopodium album, Viola arvensis, Stellaria media, Polygonum convolvulus and Galium aparine</td><td></td><td colspan="2"></td></tr>
<tr><td>Yield</td><td>“Similar”</td><td>“Similar”</td><td colspan="2">“Similar”</td></tr>
<tr><td colspan="5"></td></tr>
<tr><td rowspan="3">Feledyn-Szewczyk, B. and I. Duer 2006 C</td><td rowspan="3">Poland</td><td rowspan="3">Field exp.

1998-2001</td><td rowspan="3">Winter wheat

<u>Cropping systems:</u>
-Integrated
-Conventional
-Organic
-Monoculture</td><td rowspan="3">Soil seed bank (seedling emergence method)</td><td rowspan="3">One exp.
3 year</td><td></td><td><u>Organ.</u></td><td><u>Conv.</u></td><td><u>Integr.</u></td><td><u>Mono</u></td></tr>
<tr><td>Shannon’s Diversity index</td><td></td><td></td><td></td><td>Smal-lest</td></tr>
<tr><td>Simpson's Dominance index</td><td></td><td></td><td></td><td>Hig-hest</td></tr>
</table>

Study	Location of study	Study type	Study design			Key results			
			Explanatory variable («x»)	Response variable («y»)	Statistical analysis				
						Sorenson's Inices of similarity			
						The results showed higher similarity between soil seed banks in compared systems in terms of weed species than in number of seeds which suggests that qualitative changes in soil seed bank under different crop production systems are slower than the quantitative ones.			
Feledyn-Szewczyk, B. and I. Duer 2007.	Poland	Field exp. 2005/2006	Spring wheat <u>Cropping systems:</u> -Organic* -Conventional** -Integrated (less herbicid than C)** *white cl. and lucerne **pure stand Different rotations within cropping systems!	Weed infestation was analysed qualitatively and quantitatively in the wax ripeness of spring wheat. Weed density Weed biomass Yield	1 exp. 2 yr. Limited.		<u>Organ.</u>	<u>Conv.</u>	<u>Integr.</u>
						Weed density	30-82 pl.	5-7 pl.	
						Weed biomass	5-13 g.	2-3 g.	
						Yield			3.2 - 4.2 tons (highest)
Fischer, C., et al. 2011	Germany	Winter wheat Fields 11 landscapes / gradient of landscape complexity	Winter wheat Farming practice (ORG – CONV)	Seed removal Seed predator sampling		<u>Landscape complexity in interaction with farming practices</u>, with highest seed predation and removal rates in organic fields located in complex landscapes and in conventional fields located in simple landscapes.			
Gallandt, E. R., et al. 1998.	USA	Field exp. 1991-1995	Potato <u>3 pest management systems</u> -Conventional (CONV) -Biointensive (BIO)	Weed density Weed Biomass Potato yield	1 exp. 5 yr		CONV	BIO	RI
						Weed biomass 1991-1992	least	As RI	As BIO

Study	Location of study	Study type	Study design			Key results			
			Explanatory variable («x»)	Response variable («y»)	Statistical analysis				
			-Reduced input (RI) <u>2 soil management systems</u> -Unamended (barley/red clover rotation crop; 1x synthetic fertilizer for potato) - amended (pea/oat/hairy vetch green manure rotation crop; manure, compost, and 0.5x synthetic fertilizer for potato)			Weed biomass 1993	least	most	least
						Soil manag. 1991-1993	No influence	No influence	No influence
						Amended vs. Un-amend. 1994-1995		-77% (94) -72% (95	
						Yield 1994		No sign. effects of weeds	
						Yield 1995		-37 % (un) -12% (am)	
						Density of germinable common lambsquarters seed (0 to 10 cm soil depth): 1995 BIO system 4,082 m(-2) in the unam. soil management system. 1,280 m(-2) in the amended soil management syst. We suggest that organic amendments and green manure promote a potato crop better able to compete with weeds and that these inputs be considered as potentially important components of integrated weed management systems that have minimal reliance on herbicides.			
Glemnitz, M., et al. 2006	Italy-Finland	Climate transect Survey	Cereals: -Conv. / Integrated farming -extensive use / ORG -Fallow / set aside	Weed density	*Eight REGIONS*	In total, 768 species were found on arable fields, with most of them on fallow fields and on unsprayed extensive fields.			

<table>
<tr><th rowspan="2">Study</th><th rowspan="2">Location of study</th><th rowspan="2">Study type</th><th colspan="3">Study design</th><th rowspan="2" colspan="3">Key results</th></tr>
<tr><th>Explanatory variable («x»)</th><th>Response variable («y»)</th><th>Statistical analysis</th></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td colspan="3">Cumulative weed frequency was in general higher on fallows and extensive fields.</td></tr>
<tr><td>Gosme, M. et al. 2012</td><td></td><td>Survey

2 years</td><td>Wheat fields:
-Certified organic
-not certified organic (CONV)

Neighbourhood effects</td><td>Pests, e.g.;
Leaf blotch incidence
Aphid denisty
Weed diversity</td><td>216 wheat fields</td><td colspan="3">The results of proportional odds mixed models showed that some pests responded to local crop management: leaf blotch incidence and aphid density were significantly lower while weed diversity and abundance were higher in organic fields. Only aphids and leaf blotch responded to the neighbourhood effect: the presence of organic fields in the neighbourhood decreased the number of aphids in both organic and conventional fields and decreased leaf blotch incidence but only in conventional fields. <u>These results indicate that the increase in organic acreage in landscapes will not increase pest problems in the short term under the conditions of the study</u> (low disease pressure).</td></tr>
<tr><td rowspan="3">Graziani, F., et al. 2012</td><td rowspan="3">Italy</td><td rowspan="3">On-farm exp.</td><td rowspan="3">Cropping system
-ORG
-CONV

Combined with six rotations, different starting points
(1)legume crop (soybean/field bean/common pea),
(2) vegetable crop (pepper/melon),
(3) winter cereal (soft/durum wheat),
(4) summer cereal (maize)
(5) industrial vegetable (processing tomato),
(6) winter cereal (soft/durum wheat).</td><td rowspan="3">Weed seed bank</td><td rowspan="3"></td><td></td><td>ORG</td><td>CONV</td></tr>
<tr><td>Weed seed bank</td><td>Significant increase particularly in the case of summer weed species (Portulaca oleracea L., Amaranth us retroflexus L. and Chenopodium album L.),</td><td></td></tr>
<tr><td>Number of weed species (average)</td><td>23 (115)</td><td>20 (100)</td></tr>
</table>

Study	Location of study	Study type	Study design			Key results		
			Explanatory variable («x»)	Response variable («y»)	Statistical analysis			
			All rotations were established both in ORG and in CONV, in strict adherence to EU regulations ORG: Intercrops with green manuring, while weed control was performed mechanically in ORG CONV: Chemically/mechanically weed control			Index of diversity		Higher than ORG
						most dominant weeds as a percentage of total seedbank	56%, 32% and 4% , respectively, for P. oleracea, A. retroflexus and C. album	40%, 23% and 5%,
						These results confirm that the wider availability of effective weed control methods in integrated low-input farming systems (CONV) is helpful to maintain a low seedbank size, with a lower dominance structure. However, the adoption of ORG systems based on long rotation cycles, very competitive crops and accurate weed control, especially at the beginning of the ORG management, may be sustainable in the long run, in terms of potential weed infestation levels.		
Gruber, H., et al. 2000	Germany?	Field exp.	Conventional field transformed to: -Integrated -Organic	Weed diversity / number	1 field. 6 yr. rotation		ORG	INTEGR.
						Diversity	highest	
						Ambundance	higest	
Haghighi, R. S.,		The study was	Pest and fertility management	Weed diversity / number			ORG	CONV

Study	Location of study	Study type	Study design			Key results		
			Explanatory variable («x»)	Response variable («y»)	Statistical analysis			
et al. 2013		conducted during the 4th and 5th years of an organic rotation on part of a long term organic-conventional comparison trial 1 field. Long term exp. Results from yr. 4 and yr. 5	-ORG -CONV	Weed soil seed bank		Weed diversity	Five years of organic crop protection management increased weed species that depend on regeneration from seed	
						Seed bank Persistence index	increased	
Hald, A. B. 1999	Denmark	Survey matched pairs of long established organic and contemporary conventional cereal fields	Cereal fields Cropping system -ORG -CONV	Weed number Weed biomass (total?) Crop biomass	21 (1987) and 17 (1988) pairs (ORG and CONV)		ORG	CONV
						(total, 1987 & 1988) -Wild -Spontaneous cultural -Undersown	130 (157) 18 13	83 (100) 5 4
						Flower location (%) 1987 High Low Flowering grass 1988 High Low Flowering grass	 40 51 9 41 52 7	 16 50 34 18 31 51

<table>
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<tr><td></td><td></td><td></td><td></td><td></td><td></td><td>
<table>
<tr><td><u>Biomass*</u>
Crop
Wild

Total

*(0.5m^{-2})

Per cent wild</td><td>
256 (75)
34 (472)

293 (84)

12%</td><td>
342 (100)
7.2 (100)

349 (100)

2%</td></tr>
</table>
Even in spring, i.e. before herbicide spraying, the density of plants and species of the wild flora in conventionally farmed cereals was about half the densities in organically farmed cereals.
</td></tr>
<tr><td>Hillger, D. E., et al. 2006.</td><td>USA</td><td>Survey, 24 growers</td><td><u>Field tomato</u>

CON 1: conventional (synthetic pesticides used) processing tomato production,

CON 2: conventional fresh Market.

ORG: organic fresh market production for sale to local outlets and regional wholesale markets

Irrigation-plastic mulch-stalking-row spacing-HAND WEEDING-crop in rotation-fall tillage history-cover crop use…….</td><td></td><td>Multivariate analysis</td><td>
<table>
<tr><th></th><th><u>IPROC</u></th><th><u>R-PROC</u></th><th><u>IMFM</u></th><th><u>RMFM</u></th><th>ORG: <u>IOFM</u></th></tr>
<tr><td>Hand-weed*</td><td>2</td><td>2</td><td>46</td><td>75</td><td>280</td></tr>
</table>
*Hour of hand-weeding per ha

IPROC, irrigated processing; RPROC, rain-fed processing; IMFM, irrigated mixed fresh market; RMFM, rain-fed mixed fresh market;
IOFM, irrigated organic fresh market.

Farmers generally reported many more hours of hand-weeding for organically managed fields than for fields in the other groups. This finding may reflect a trade-off between the use of herbicides and the need for hand-weeding.
</td></tr>
</table>

<table>
<tr><th rowspan="2">Study</th><th rowspan="2">Location of study</th><th rowspan="2">Study type</th><th colspan="3">Study design</th><th rowspan="2">Key results</th></tr>
<tr><th>Explanatory variable («x»)</th><th>Response variable («y»)</th><th>Statistical analysis</th></tr>
<tr>
<td>Hiltbrunner, J., et al. 2008</td>
<td>Switzerland</td>
<td>Field exp.</td>
<td>Long term experiment, started in 1991

-ORG
-INTEGR. Extensive (IFext)
-INTEGR. Intensieve ((IFint)

<u>Rotation:</u>
-Winter wheat
-Maize
-Summer/winter barley
-Potatoes/oilseed rape
-Grassland, temporary

<u>Weed control:</u>
ORG: mechanical weed control
IFext: herbicide + Mech.
IFint: herbicide

<u>Fertlization (N supplied):</u>
ORG: 61%
IFext: 74%
IFint: =100%</td>
<td>Weed diversity
Weed dynamic</td>
<td></td>
<td>
<table>
<tr><td></td><td><u>ORG</u></td><td><u>IF ext</u></td><td><u>IF int</u></td></tr>
<tr><td>Wheat:
Total weed cover*</td><td>7x</td><td>3x</td><td>1x</td></tr>
<tr><td>Wheat yield kg/ha</td><td>5458 b
(80)</td><td>5766 b
(85)</td><td>6782 a
(100)</td></tr>
<tr><td>Maize:
Total weed cover*</td><td>15x</td><td>4x</td><td>1x</td></tr>
<tr><td>Maize yield Kg/ha</td><td>11859
(91)</td><td>11876
(92)</td><td>12967
(100)</td></tr>
<tr><td>Weed diversity</td><td>higher</td><td colspan="2">lower</td></tr>
<tr><td>Grassland</td><td colspan="3">ORG: Taraxacum officinale and Rumex obtusifolius increased with time and dominated the weed community in the maize which followed.</td></tr>
<tr><td>Wheat</td><td colspan="3">Chenopodium and Polygonum species dominated in the wheat, especially in ORG</td></tr>
<tr><td colspan="4">*Prior to harvest

We conclude from this study that an optimal combination of direct and indirect means for controlling weeds would allow organic farming at this site, provided that problematic weeds (e.g. Elytrigia repens and Rumex obtusifolius) can be kept at the low level observed at the end of 2006.</td></tr>
</table>
</td>
</tr>
</table>

Study	**Location of study**	**Study type**	**Study design**			**Key results**		
			Explanatory variable («x»)	Response variable («y»)	Statistical analysis			
Hyvonen, T. , 2007	Finland	Data of two weed surveys of spring cereals (conducted in 1961-1964 and 1997-1999) in Finland	<u>Spring cereals</u> -ORG -CONV.	<u>Weeds</u> -Frequency of occurrence -Density (plants m^{-2}) of 41 weed species	Partial canonical correspondence analysis (pCCA)		<u>ORG</u>	<u>CONV</u>
						Frequency 1	8 species had <u>lower</u> frequency in the 1990s' ORG fields than in the 1960s	
						Frequency 2	30 species had <u>higher or similar</u> frequency in the 1990s' ORG fileds than in the 1960s e.g. Cirsium arvense 18-18 Elymus repens 35-100 Stachys palustris 4-9 Sonchus arvensis 20-55	
						Density 1	18 species had <u>lower</u> <u>d</u>ensity in ORG fields than in the fields of the 1960s	
						Density 2	20 species had <u>higher or similar</u> density in ORG fields than in the 1960s	
	-Crop and under-sown grass explained more of the variation in species composition in the 1990s than in the 1960s. -The role of drainage and pre-crop was more important in the 1960s than in the 1990s. -The most immediate benefit was gained by nitrophilous species that had suffered from herbicide application. -The recovery of perennials and non-nitrophilous species will take a longer time. -The results suggest that despite some benefits for biodiversity, organic farming at early phase cannot recover weed populations to the same level as before application -of							

<table>
<tr><th rowspan="2">Study</th><th rowspan="2">Location of study</th><th rowspan="2">Study type</th><th colspan="3">Study design</th><th rowspan="2">Key results</th></tr>
<tr><th>Explanatory variable («x»)</th><th>Response variable («y»)</th><th>Statistical analysis</th></tr>
<tr><td></td><td colspan="6">intensive cropping measures.</td></tr>
<tr><td rowspan="2">Hyvonen, T., et al. 2003</td><td>Finland</td><td>Survey</td><td>Spring cereals
-ORG
-CONV cereal
-CONV dairy cropping

Samples were taken before (May-June) and after (July-August) the treatment of conventional fields with herbicides</td><td>-Species number</td><td></td><td><table>
<tr><th></th><th>ORG</th><th>CONV cer</th><th>CONV da</th></tr>
<tr><td>Species per field*</td><td>X+2</td><td>x</td><td>x</td></tr>
<tr><td>Total number of species</td><td>Higher Juy-August</td><td></td><td></td></tr>
<tr><td colspan="4">*Both May-June and July-August</td></tr>
</table></td></tr>
<tr><td colspan="6">-The species composition of organically cultivated fields was closer to that of conventional dairy than to that of conventional cereal fields
-Species susceptible to herbicides (e.g. Chenopodium album) were abundant in organically cultivated fields in both sampling periods whereas the relative abundance of some of them declined in conventional fields from May-June to July-August.
-In conventional fields, the relative abundances of Viola arvensis, Stellaria media and Elymus repens increased from May-June to July-August.
-Only weak support was found for the hypothesis that organic cropping favors less-nitrophilous weed species.
-It is concluded that organic cropping promotes weed species diversity at an early phase of cropping history but that a change in species composition would require a longer period of organic cropping.</td></tr>
<tr><td>Hyvonen, T. and J. Salonen 2005</td><td>Finland</td><td>Field exp.
1990-2000</td><td><u>Crop rotation</u>:
-Spring barley /undersow cl.&gr.
-Grassland (forage)
-Grassland (forage)
-Winter rye
-oat-pea mix.

<u>Combined with</u>
-Low input
-Conventional cropping
LOW: Cattle manure,18-8-39
No herbicides</td><td></td><td></td><td><table>
<tr><th></th><th><u>LOW input</u></th><th><u>CONV</u></th></tr>
<tr><td><u>Rye</u>
Yield</td><td>1436.3 (54)</td><td>2657.4 (100)</td></tr>
<tr><td>Crop biomass</td><td>426</td><td>217.7</td></tr>
<tr><td>Total weed bio</td><td>51.8 (173)</td><td>30 (100)</td></tr>
<tr><td>Ann. weed bio</td><td>22.9 (402)</td><td>5.7 (100)</td></tr>
<tr><td>Per.weed bio</td><td>28.9 (118)</td><td>24.4 (100)</td></tr>
</table></td></tr>
</table>

Study	**Location of study**	**Study type**	**Study design**			**Key results**		
			Explanatory variable («x»)	Response variable («y»)	Statistical analysis			
			CON: NPK fertilizer, 105-26-43 MCPA (barley), met….(rye), bentazon/MCPA (oat-pea) (no use of herb. In 2005)			Oat-pea Yield	1964 (74)	2642 (100)
						Crop biomass	420.5	561.9
						Total weed bio	41.2 (174)	23.7 (100)
						Ann. weed bio	10.7 (181)	5.9 (100)
						Per.weed bio	30.5 (172)	17.7 (100)
						Barley Yield	2175 (63)	3456.1 (100)
						Crop biomass	425	626.4
						Total weed bio	54.9 (184)	29.8 (100)
						Ann. weed bio	14.4 (758)	1.9 (100)
						Per.weed bio	40.6 (145)	28.0 (100)
						The clear dominance of a perennial weed species, Elymus repens, resulted in a more skewed distribution of abundance for conventional than for low-input crop management systems. E. repens was the only species that was more abundant in conventional than in low-input cropping. The most abundant species were largely similar in both systems. In general, the species composition differed more between autumn (rye) and spring-sown crops (barley and oat-pea) than between the crop management		

<table>
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<tr><td rowspan="2"></td><td></td><td></td><td></td><td></td><td></td><td colspan="3">systems. The weed community of rye fields was characterized by several perennial species and some autumn-germinating annuals. This pattern was observed especially in low-input fields.</td></tr>
<tr><td colspan="8">Specifications:
Mouldboard ploughing of 20 cm (autumn or sprinh not specified. / No comments whether weed harrowing in LOW!</td></tr>
<tr><td rowspan="4">Jose-Maria, L. and F. X. Sans 2011.</td><td rowspan="4">Medi-terranean</td><td rowspan="3">Fifteen locations were selected in a dryland cereal region situated in Central Catalonia.</td><td rowspan="3">Cropping system:
-ORG
-CONV

And influence of surrounding landscape</td><td rowspan="4">Weed seed bank</td><td rowspan="4"></td><td></td><td><u>ORG</u></td><td><u>CONV</u></td></tr>
<tr><td>Species richness (ca, numbers from Table 1)</td><td>Edge 12
Centre 9.5</td><td>Edge 9.25
Centre 6</td></tr>
<tr><td>Species richness
Rel. importance RI</td><td>Herbicide use
Seed origin
Crop diversity
Farm type
Grazing
Nitrogen input
Weed harrow.
Previous crop</td><td>0.787 -
0.743 -
0.307 +
0.303 -
0.301 -
0.289 -
0.288 -
0.250 +</td></tr>
<tr><td colspan="2">In each location, an organic field and a conventional field were selected, which were cropped with winter cereals (wheat or barley) during the period 2007–2008.</td><td>Seedling density
RI</td><td>Seed origin
Herbicide use
Nitrogen input
Previous crop
Crop diversity
Weed harrow
Farm type
Grazing</td><td>0.870 -
0.819 -
0.468 -
0.404 +
0.339 +
0.292 -
0.267 +
0.265 +</td></tr>
</table>

<table>
<tr><th rowspan="2">Study</th><th rowspan="2">Location of study</th><th rowspan="2">Study type</th><th colspan="3">Study design</th><th colspan="5" rowspan="2">Key results</th></tr>
<tr><th>Explanatory variable («x»)</th><th>Response variable («y»)</th><th>Statistical analysis</th></tr>
<tr><td></td><td colspan="10">Farmers information: use of herbicides (H), weed harrowing with long-flex spring tines (WH), mean annual inputs of exogenous nitrogen (N, calculated by means of local tables of nitrogen content), seed origin (SO, purchase of commercially available seeds or reuse of own seeds), crop species diversity (CD, number of different plant-families cropped), farm type according to its production orientation (FT, crop-specialised farms solely involved with growing crops vs. mixed farms, also including livestock), grazing after crop harvest (G) and previous crop (PC, during the period 2006–2007).

The high seedling densities reported reflect the lack of appropriate weed management among organic farmers, the majority of whom did not carry out any mechanical weed control during the cropping period (see Table 1).Weed harrowing with long-flex spring tines had only a moderate negative effect on both seedbank species richness and size (Table 4), which supports the idea that mechanical weed control is less effective than herbicides, particularly if fields are only harrowed once (Ulber et al., 2009). Therefore, weed harrowing was not a sufficient measure per se for controlling weediness in organic fields, at least with the frequency of current use.

In the Appendix: Seedling density (seedlings m)2) by species in seedbank of edges (E) and centres (C) of organic and conventional cereal fields. Only species recorded in more than 5% of the samples are listed.</td></tr>
<tr><td rowspan="4">Karkanis, A., et al. 2012</td><td rowspan="4">Greece</td><td rowspan="4">Field exp.
Certified org.
2009-2010</td><td rowspan="4">Leek (Allium porrum)
-CONV
-ORG</td><td rowspan="4">Weed number
Weed biomass
Leek yield</td><td rowspan="4">ANOVA / LSD</td><td></td><td>Control</td><td>Mulching (“ORG”)</td><td>Pendi-methalin Herb. 1</td><td>Oxy-fluorfen Herb.2</td></tr>
<tr><td>2009 Total weed numb.</td><td>79^{a} (100)</td><td>26.5^{c} (34)</td><td>33.25^{b} (42)</td><td>6.75^{d} (9)</td></tr>
<tr><td>2009 Total weed biom.</td><td>740.4^{a} (100)</td><td>392.6^{b} (53)</td><td>365.2^{b} (49)</td><td>52.3^{c} (7)</td></tr>
<tr><td>2010 Total weed numb</td><td>67.5^{a} (100)</td><td>21^{c} (31)</td><td>28.5^{b} (42)</td><td>6^{d} (9)</td></tr>
</table>

Study	Location of study	Study type	Study design			Key results				
			Explanatory variable («x»)	Response variable («y»)	Statistical analysis					
						2010 Total weed biom.	810.4^{a} (100)	397.5^{b} (49)	377.8^{b} (47)	53.6^{c} (7)
						2009 Leek yield	32.340^{c} (100)	47.580^{b} (147)	51.040^{b} (158)	62.500^{a} (193)
						2010 Leek yield	34.520^{c} (100)	51.200^{b} (148)	53.750^{b} (156)	67.400^{a} (195)
Kaut, A. H. E. E., et al. 2008	Canada	Field exp. 2003-2005 7 location-years	<u>Cropping system</u> -ORG -CONV -Edmonton CONV. (University) -Edmonton ORG (University) -Certfied ORG. Mixtures of wheat and spring cereals	-Cereal Yield -Weed number -Weed biomass	SAS MIX.		<u>Cert. ORG</u>	<u>Edm. ORG</u>		<u>Edm. CONV</u>
						Weed biomass*	190 (3800)	200 (4000)		5 (100)
						Grain yield**	1.34 (31)	2.8 (64)		4.36 (100)
						*g (DW) m^{-2} at grain maturity **t ha^{-1}				
	(1) on conventionally managed land, wheat-barley mixtures exhibited potential for yield maintenance and weed suppression (2) on organically managed land, competition with weeds had a large negative effect on yield (>30%). The 25:75 mixtures of wheat and oats, and all mixtures of Park (a heritage) wheat and Manny barley exhibited yield potential similar to or (up to 1.0 t ha⁻¹) greater than monocrop yield. Manny barley mixtures exhibited weed suppressive capabilities.									
Kaut, A. H. E. E., et al. 2009	Canada	Field exp. 2003-2005 8 location-years	<u>Cropping system</u> -ORG (2 sites) -CONV (1 site) Mixture of spring wheat variety	-Cereal Yield -Weed number -Weed biomass			<u>Cert. ORG</u>	<u>Edm. ORG</u>		<u>Edm. CONV</u>
						Weed biomass*	230 (1533)	160 (1100)		15 (100)

<table>
<tr><th rowspan="2">Study</th><th rowspan="2">Location of study</th><th rowspan="2">Study type</th><th colspan="3">Study design</th><th rowspan="2" colspan="4">Key results</th></tr>
<tr><th>Explanatory variable («x»)</th><th>Response variable («y»)</th><th>Statistical analysis</th></tr>
<tr><td rowspan="3"></td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2">mixtures

two levels of simulated weed (Brassica juncea L.) competition</td><td rowspan="2"></td><td rowspan="2"></td><td>Grain yield**</td><td>1.08
(24)</td><td>3.42
(77)</td><td>4.44
(100)</td></tr>
<tr><td colspan="4">*g (DW) m^{-2} at grain maturity
**t ha^{-1}</td></tr>
<tr><td colspan="9">- Early season vigour was strongly associated with yield, with the strongest correlation occurring under low-moisture, low-nutrient, high-competition conditions at the certified organic farm.
- Spring wheat variety mixtures may provide greater stability with little or no reduction in yield, while providing greater competitive ability.</td></tr>
<tr><td rowspan="6">Kirchmann, H., et al. 2007</td><td rowspan="5">Sweden</td><td rowspan="5">Field study
18 yr.</td><td rowspan="5">Crop-livestock systems
Grassland

Cropping system:
-ORG
-CONV

On a highly P and K depleted soil in southern Sweden that had not received any inorganic fertilizers (or pesticides) since the mid-1940s.</td><td rowspan="5">-Crop yield
-Weed biomass
-Soil nutrients….</td><td rowspan="5"></td><td colspan="2"></td><td><u>ORG</u></td><td><u>CONV</u></td></tr>
<tr><td colspan="2">Crop yields (average)</td><td>50</td><td>100</td></tr>
<tr><td colspan="2">Weed biomass</td><td>1–3 Mg dry matter ha^{-1} higher</td><td></td></tr>
<tr><td colspan="2"></td><td></td><td></td></tr>
<tr><td colspan="4">-Nitrogen was identified as the main yield-limiting nutrient for organically grown crops.
-Despite this, and even with use of cover crops, N leaching was not reduced by organic farming.</td></tr>
<tr><td colspan="9">The major management differences between the systems were
(i) growth of legumes every second year and use of legumes as cover crops in the organic rotation;
(ii) application of P in the organic system at higher rates than for the conventional system;
(iii) exclusion of oilseed rape (Brassica napus L.) from the organic system but inclusion of potato (Solanum tuberosum L.);
(iv) frequent mechanical weeding in the organic system; and
(v) use of solid manure in the organic and liquid manure in the conventional system.</td></tr>
</table>

Study	Location of study	Study type	Study design			Key results		
			Explanatory variable («x»)	Response variable («y»)	Statistical analysis			
Kovalev, N. G., et al. 1995	Russia	Field «Long term»	Oat-barley-Winter rye Systems: Organic Conv.	-Yield -Weed (number, Biomass?)			ORG	CONV
						Oat, yield*	3.14 (79)	4.00 (100)
						Barley, yield*	3.06 (74)	4.16 (100)
						Winter rye, yield*	4.10 (67)	6.09 (100)
						Trifolium and lupin seed prod.	Same level	
						Weeds	Same level (Correct??)	
						*t ha^{-1} Abstract: -13,5% lower yield in organic????		
Krawczyk, R., et al. 2010	Poland	*Field* *2006-2009*	Winter wheat cultivars, under conversion 1. Conv. to Org. 2. Conv. Conv. + seeding rates 450 vs. 800 seeds + strip cropping Factorial design Weed harrowing?	-Weed species number -Weed biomass -Shannon's diversity index -Simpson dom. Index			ORG (Conversion)	CONV
						450 seeds: Weed number	112c	71abc
						800 seeds: Weed number	80bc	37a
						Strip cropping: Weed number	77bc	70ab
						450 seeds: Weed biomass	196,90b	111,43ab
						800 seeds: Weed biomass	111,94ab	36,05a

Study	Location of study	Study type	Study design: Explanatory variable («x»)	Study design: Response variable («y»)	Study design: Statistical analysis	Key results		
						Strip cropping: Weed biomass	120,02ab	79,02a
						Weed number	90 (158)b	57 (100)a
						Weed biomass*	143 (188)b	76 (100)a
						Diversity index	higher	
						Weed species	Most dicotyle-donous weeds, esp. Matricaria maritime	Dominating weed: Apera spica-venti (åkerkvein) and Viola spp.
						*g (DW) m^{-2}		
						Increasing seeds from 450 to 800 or strip cropping in ORG decerased weed biomass with 43% and 39 respectively. (Conv. : -68% and 29%)		
Kus, J., et al. 2010	Poland	Field Exp.station 2005-2007 Four varieties during 3 yr.	<u>Winter wheat cultivars,</u> 1. Org. 2. Conv. Weed harrowing?	-Yield -Weed number -Weed biomass And diseases…			<u>ORG</u>	<u>CONV</u>
						Yield	80	100
						Different varieties gave best and lowest yield for Org and Conv. Very old var. was not useful! Density of crop canopy more important than morphological features of the varieties		
Mason, H. E., et al. 2007.	Cananda	Field 3 year	<u>Spring wheat cultivars</u> 1. Org.	-Yield -Weed number -Weed biomass			<u>ORG</u>	<u>CONV</u>
						Yield	61	100

Study	Location of study	Study type	Study design			Key results		
			Explanatory variable («x»)	Response variable («y»)	Statistical analysis			
		Sites?	2. Conv. Different traits like time of flowering and height versus yield and competition			Weed biomass	Sign. greater	
						-Average conventional yields were 63% greater than organic yields, (or 39% reduced in org.)		
						-Crop cultivars developed before the advent of modern, high-input agriculture may be better suited to lower soil nutrient levels and elevated weed competition -Criteria for yield and weeds versus cereal traits discussed and concluded! Different for the two systems -A competitive crop ideotype for organically grown spring wheat in northern growing regions of the Canadian Prairies should include taller plants, with fast early season growth, early maturity, and elevated fertile tiller number.		
Mason, H. E. and D. Spaner 2006	Canada	**Review**	Competitive ability of wheat in conventional and organic management systems		*Not relevant*	Wheat varieties with superior performance in low-input systems, and/or increased competitive ability against weeds, could assist organic producers in overcoming some of the constraints associated with organic wheat production.		
Melander, B., et al. 2005	General / Denmark	Review	Most crops Direct and preventive methods of weed control	-Yield -Weed number -Weed biomass	*Not relevant*	Strategies: (not one simple treatment) Ex: Weed harrowing and interrow hoeing provide promising results when they are part of a strategy that also involves cultural methods such as fertilizer placement, seed vigor, seed rate, and competitive varieties.		
	Although research in preventive, cultural, and physical methods have improved weed control in row crops and small-grain cereals, effective long-term weed management in low external input and organic systems can only be achieved by tackling the problem in a wider context, i.e., at the cropping system level. Basic principles of this approach, examples of cover crop and intercropping use for weed suppression, and an application in a 2-yr rotation are presented and discussed.							
Minarro, M.	Spain	Field exp.	Apple orchards	-Weeds, floristic and			ORG	CONV

Study	Location of study	Study type	Study design			Key results		
			Explanatory variable («x»)	Response variable («y»)	Statistical analysis			
2012		2 yr. study 3 locations /sites	-fertilization (organic vs. chemical) -Row management: 1.herbicide, 2.tillage, 3.straw mulching	functional traits		Tillage	Favoured therophytes	
						Herbicide	Favored hemicryptophytes	
						Mulching	Decreased proportion of therophytes at the expense of hemicryptophytes.	
						all	Cryptophytes were not affected by the treatments	
Moreby, S. J., et al. 1994	Southern England	Field	Winter wheat -Organic fields paired with neighbor -Conv. fields	-Weed number -Weed biomass (?) -Arthropod fauna (ledd-dyr, insekter edderkopper….)			ORG	CONV
						Broad leaved weed species	(3x) 300	(1x) 100
	CONV: Significantly higher densities of nematoceran and acalypteran Diptera, Hemiptera (especially aphids), aphid-specific predators, parasitic Hymenoptera and cryptophagid and cantharid Coleoptera. **ORG**: Significantly higher densities of weevils, spiders, springtails, plant hoppers and sawfly larvae.							
Navntoft, S., et al. 2009	New Zealand	Field studied in autumn in **eight** organic and **eight** conventional mixed cropping fields in New Zealand	-CONV -ORG	Weed seeds predation			ORG	CONV
						Seed removal rate*	17%	10%
						*although variation was high.		

Study	Location of study	Study type	Study design: Explanatory variable («x»)	Study design: Response variable («y»)	Study design: Statistical analysis	Key results
	-Predation rates were estimated by observing removal rates of seeds of the annual weeds fathen or common lambsquarter (Chenopodium album) and Persian speedwell (Veronica persica). The seed losses were recorded at distances of 0, 3,9 and 50 in from the field edge. Removal rates were recorded after 48 h. -There was also a strong tendency towards higher seed losses at **organic field edges**. -Vegetation had a significant influence on the predation rates, with maximum rates **at a medium-dense plant cover**. - Based on the video images, birds were the most important seed predators. The higher weed seed predation rate in the organic fields indicates that there may be an economic advantage associated with the well-established trend that **bird populations** are generally higher in organic agricultural situations.					
Nazarko, O. M., et al. 2003	Canada	Survey A total of 71 farmers, representing 120 fields and 11 crops, participated in the study.	Spring cereals ++	-Yield -Weed density		Columns: ORG cert. / ORG non-cert. (‘nc’) / CONV Yield: Slightly lower / Slightly lower / highest Weed density: Lower than’ nc’ / higher /
	-A novel approach, Pesticide Free Production (PFP) -Fields and farmers were grouped based on whether or not fields (i) achieved PFP certification and (ii) were in transition to organic production. Certification was achieved for 83% of the participating area. Spring cereals were the most likely crops to achieve PFP certification. -Pesticide Free Production demonstrates considerable potential to be successfully adopted by mainstream farmers.					
Pilipavicius, V. 2005	Lithuania	Field ex.	Spring barley -CONV -ORG	-Weed biomass -Weed Number -Yield At different cereal dev. stages		Columns: ORG / CONV Crop yield and biomass*: 9-12 t / 12-17t The highest of barley were obtained from the late milk to early dough stages: 22-31 and 9-12 t/ha under organic farming; and 26-59 and 12-17 t/ha under conventional farming, respectively.

Study	Location of study	Study type	Study design			Key results		
			Explanatory variable («x»)	Response variable («y»)	Statistical analysis			
Pollnac, F. W., et al. 2008		Field	<u>Spring wheat</u> -CONV -ORG Spatial patterns	Weeds: -Aggregation measures -quadrat variance			<u>ORG</u>	<u>CONV</u>
						Spatial patterns*	multiple scales of patchiness with few gaps	patch/gap pattern
	<u>Background:</u> Heterogeneous field conditions are ubiquitous throughout agricultural systems and have given rise to the practice of site-specific management, in an effort to increase sustainability and/or homogenise growing conditions and thereby increase crop yields. The spatial pattern of weeds in conventional systems is widely accepted to be aggregated, but there have been no scientific studies regarding the spatial pattern of weed distribution in organic systems. <u>*Results</u>: Weed cover was aggregated in both the conventional and the organic systems, but the patterns of aggregation were different for the two systems. Conventional no-tillage systems showed a patch/gap pattern, while organic systems showed multiple scales of patchiness with few gaps. These results suggest that processes causing aggregation in the two systems may be different and that site-specific management may be applicable to organic systems as well as conventional spring wheat systems.							
-Raffaelli, M., et al. 2010	Italy	Field exp. 2006-2007 'on farm' exp.	<u>Lef-beet</u> -CONV -ORG CONV: transplanted plants ORG: seeding (machine)	-Weed biomass -Weed Number -Yield LABOR TIME			<u>ORG</u>	<u>CONV</u>
						Labor time* (2006)		-67%
						Labor time* (2007)		-40%
						Weed biomass**	-50%	

Study	Location of study	Study type	Study design: Explanatory variable («x»)	Study design: Response variable («y»)	Study design: Statistical analysis	Key results		
						2006 Physical weed control	21 h ha^{-1}	0 h ha^{-1}
						2006 hand weeding	259 h ha^{-1}	0 h ha^{-1}
						2006 spraying	0 h ha^{-1}	8 h ha^{-1}
						2007 Physical weed control	11 h ha^{-1}	0 h ha^{-1}
						2007 hand weeding	37 h ha^{-1}	0 h ha^{-1}
						2007 spraying	0 h ha^{-1}	6 h ha^{-1}
						2006 weed biomass	5.9 g m^{-2} (46) b	12.8 g m^{-2} (100) a
						2007 weed biomass	4.4 g m^{-2} (34) b	12.9 g m^{-2} (100) a
						2006 Yield	33.4 Mg ha^{-1} (91) ns	36.9 Mg ha^{-1} (100) ns
						2007 Yield	30.8 Mg ha^{-1} (101) ns	30.6 Mg ha^{-1} (100) ns
						*weed management + crop planting. Improvements explain less difference in 2007 vs. 2006. **at harvest		
Raffaelli, M., et al. 2011	Italy	Field	Processing tomatos -CONV	-Weed biomass -Weed Number -Yield			ORG	CONV
						Labour input	+50%*	

<table>
<tr><th rowspan="2">Study</th><th rowspan="2">Location of study</th><th rowspan="2">Study type</th><th colspan="3">Study design</th><th rowspan="2" colspan="4">Key results</th></tr>
<tr><th>Explanatory variable («x»)</th><th>Response variable («y»)</th><th>Statistical analysis</th></tr>
<tr><td rowspan="7"></td><td rowspan="6"></td><td rowspan="6"></td><td rowspan="6">-ORG

2006-2008. (three seasons)</td><td rowspan="6">LABOR TIME</td><td rowspan="6"></td><td>Weed biomass*</td><td colspan="2">68 g m^{-2}
(189)</td><td>36 g m^{-2}
(100)</td></tr>
<tr><td>Yield*</td><td colspan="2">113</td><td>100</td></tr>
<tr><td>2006 labour</td><td colspan="2">54.1 h ha^{-1}
(361)</td><td>15 h ha^{-1}
(100)</td></tr>
<tr><td>2007 labour</td><td colspan="2">42 h ha^{-1}
(372)</td><td>11.3 h ha^{-1}
(100)</td></tr>
<tr><td>2008 labour</td><td colspan="2">61 h ha^{-1}
(122)</td><td>50 h ha^{-1}
(100)</td></tr>
<tr><td colspan="4">*Correct?</td></tr>
<tr><td colspan="9">CONV: The conventional strategy consisted of three different chemical treatments, two post-transplanting PTO-powered rotary hoe passes and several hand-weeding treatments on the paired rows.
ORG: The alternative system included a stale seedbed technique (performed by a rolling harrow pass and one flaming treatment), two post-transplanting precision hoeing treatments and several hand-weeding treatments. All the machines for the alternative system were adjusted and set up for processing tomatoes transplanted in paired rows.
*More details about weed registrations and Yield (each year) in the whole paper.</td></tr>
<tr><td rowspan="4">Rebarz, K., et al. 2006</td><td rowspan="3">Poland</td><td rowspan="3">Field exp.
2001-2004</td><td rowspan="3"><u>Potato</u>

-CONV
-INTEGRATED
-ORG

+/- Irrigation</td><td rowspan="3">-Weed density
-Weed biomass</td><td rowspan="3"></td><td></td><td><u>ORG</u></td><td><u>INT</u></td><td><u>CONV</u></td></tr>
<tr><td>Weed biomass*</td><td>210</td><td>270</td><td>100</td></tr>
<tr><td colspan="4">*The dominant weeds were Chenopodium album, Polygonum convolvulus and Echinochloa crus-galli.</td></tr>
<tr><td colspan="9">Under irrigated conditions, the number of weeds decreased with increase in the intensity level in the cultivation systems, whereas under non-irrigated conditions, the organic</td></tr>
</table>

Study	Location of study	Study type	Study design			Key results		
			Explanatory variable («x»)	Response variable («y»)	Statistical analysis			
	and integrated systems was significantly higher compared to the conventional system.							
Rhainds, M., et al. 2002	USA, (North-eastern)	Field 4 fruiting seasons	<u>Strawberry</u> -CONV -ORG 3 cultivars	-Crop assessments Number of fruits Average weight (fruit) -Pests Diseases* Insects* Weeds *most focus			<u>ORG</u>	<u>CONV</u>
						Number fruits	-	higher
						Average weight	equal	equal
						Weed biomass**	higher	-
						**Biomass showed in a figure, not specified values		
	-Economic analysis indicated that a lack of reliable, effective measures for managing pests of strawberries without synthetic pesticides, especially weeds and plant bugs, may severely constrain yield and profitability of organic strawberries in the northeastern United States. -Due to its high productivity and low susceptibility to plant bugs, Honeoye was by far the most profitable cultivar in this study, and appeared highly suitable for organic management.							
Romero, A., et al. 2008	NE Spain (Central Catalonia)	Survey 2003-2004 36 cereal fields 9 agricultural sites Pair of CONV and ORG	<u>Winter cereal fields.</u> Crop Edges -CONV -ORG	Weeds: In crop edges and inner fields -Weed cover -Species richness -Hill's first order diversity			<u>ORG</u>	<u>CONV</u>
						Weed cover	increase	
						Species richness	increase	
						Hill'diversity	incresae	
	-Shift in weed vegetation composition, which favoured potentially rare arable, broad-leaved, insect-pollinated and legume weeds. -Weed diversity was concentrated in the crop edges, especially in the weed communities of conventional cereal fields, which were found to be more spatially heterogeneous than the organic ones.							

Study	Location of study	Study type	Study design			Key results		
			Explanatory variable («x»)	Response variable («y»)	Statistical analysis			
Roschewitz, I., et al. 2005	Germany (north) Göttingen	Field / survey 24 winter wheat fields	-Winter wheat fields Landscape complexity & -CONV -ORG.	-Ruderal vegetation -Seed bank Alfa diversity Beta diversity Gamma diversity			ORG	CONV
						Weed species diversity	higher	
						Seed rain	higher	
						Seed bank	higher	
	-Weed species diversity in the vegetation, seed rain and seed bank was higher in organic than in conventional fields - Increasing landscape complexity enhanced species diversity more strongly in the vegetation of conventional than organic fields, to the extent that diversity was similar in both farming systems when the landscape was complex. -Species diversity of the seed bank was increased by landscape complexity irrespective of farming system							
Rydberg, N. T. and P. Milberg 2000	Sweden	Survey 57 arable fields 17 organic farms	-Organic The relative importance of some farming practices was evaluated -crop, -preceding crop, -undersown ley, -weed harrowing, -weed hoeing, -ploughing regime,	pCCA (partial Canonical Correspondence Analysis)			ORG	CONV*
						Number of weeds	higher	
						Typical weeds	*Centaurea cyanus Vicia hirsuta*	More Nitro-philous species
						*Unsprayed control plots in herbicide trials		

Study	Location of study	Study type	Study design: Explanatory variable («x»)	Study design: Response variable («y»)	Study design: Statistical analysis	Key results		
			-compost, -animal husbandry and -biodynamic agriculture.			ORG		
						Most important (for explaining the variation in the weed flora): -Weed species -The crops (beans and peas) – *Centaurea cyanus* -Ley as preceding crop – *Cerastium fontanum* -weed hoing -Fallowing in the preceding (*Lamium* spp.) -Animal husbandry (*Sinapis arvensis*)		
	-A number of species considered endangered, rare or decreasing in Sweden were recorded on these farms, suggesting that organic farming can contribute to maintaining biodiversity in an agricultural landscape. -The weed flora was also compared with that of unsprayed control plots in herbicide trials. Ranking weeds according to either frequency or a pCCA both showed clear differences, with organic fields having many more weeds. -Species typical of organic farming were Centaurea cyanus and Vicia hirsuta. -There was a tendency for weed species that dominate in conventional farming to be more nitrophilous than those species characteristic in organic farming.							
Salonen, J. and T. Hyvonen, 2002	Finland Southern and central Finland	Survey 16 regions 1997-1999 -457 fields conventional -165 organic production	Spring cereals -ORG -CONV	Weed species / number			ORG	CONV
						'Problematic weeds'	Elymus repens, Cirsium arvense Sonchus arvensis	
	-Roughly half of the 189 species observed were perennials but the majority were of minor importance in terms of frequency and abundance. -However, the problems caused to crop production by the three most abundant perennials, Elymus repens, Cirsium arvense and Sonchus arvensis, are pronounced, particularly in organic cropping with its diverse crop rotation and less intensive weed control.							

Study	Location of study	Study type	Study design: Explanatory variable («x»)	Study design: Response variable («y»)	Study design: Statistical analysis	Key results
Salonen, J., et al. 2001 A	Finland Southern and central Finland	Survey 1997-1999 -165 fields organic production	Spring cereals -ORG	-Weed number -weed biomass Fields were assessed from Mid-July to Mid-August		ORG: Average density: 469 m^{-2} Average, biomass: 678 kg ha^{-1} (17% of total crop stand)
	-A total of 126 weed species were found, of which 42 exceeded the frequency level of 10%. -The most frequent weed species were *Chenopodium album, Stellaria media, Galeopsis* spp. and *Viola arvensis*. -*Elymus repens* was the most frequent grass species. -Infestation by *Chenopodium album* and the perennial species *Elymus repens, Cirsium arvense* and *Sonchus arvensis* is of major concern. -Weed control strategies should include direct control measures to overcome weed problems related to the conversion period from conventional to organic growing.					
Salonen, J., et al. 2001 B	Finland (Southern and central Finland)	Survey 16 regions 1997-1999 690 fields	Spring cereals -ORG -CONV (applied their normal cropping practices)	Weed number -weed biomass Fields were assessed from late-July to early-August		(ORG / CONV) Average species number per field: 24 / 16 Average density (m^{-2}): 469 / Sprayed = 136, Unspr. = 420 Average, biomass: 678* / Sprayed = 163*, Unspr. = 605* % of crop stand (biomass): 17% / Sprayed =3%

Study	Location of study	Study type	Study design: Explanatory variable («x»)	Study design: Response variable («y»)	Study design: Statistical analysis	Key results		
	*kg ha^{-1} -Altogether 160 weed species were found, of which 134 were broad-leaved and 26 grass species. The total number of weed species ranged from 41 to 84 between regions.							
Salonen, J., et al. 2005	Finland	Survey 2002-2003 119 conv. Fields 64 org. fields	Field peas (*Pisum sativum* L.) -ORG -CONV				ORG	CONV
						average number of weed species per field	18	10
						Explaining species comp.**	Features of crop stand and weed control explained 38.7% and 37.6% of the variation respectively	The age of crop stand and field location (y co-ordinate) respectively explained best the variation.
						Most frequent weed species*	Chenopodium album, Stellaria media and Viola arvensis Elymus repens was the most frequent grass species.	
						*in both systems **composition		
	CONV: Herbicides were applied to 92% of conventionally cropped fields where they provided relatively good control but were costly. ORG: Weeds were controlled mechanically only in five fields under organic production. CONV: Weeds could be efficiently managed with herbicides under conventional cropping, ORG: Weeds represented a significant problem for organic production. Mixed cultivation of pea with cereals is recommended, particularly for organic cropping, as it favours; crop competition against weeds.							
Salonen, J., et al.	Finland	Survey	Spring cereals	-Weed number			ORG	CONV

Study	Location of study	Study type	Study design			Key results		
			Explanatory variable («x»)	Response variable («y»)	Statistical analysis			
2011		16 regions, 283 farms 595 fields -72 ORG fields -523 CONV fiel. (of which 503 were treated with herbicides)	2007-2009	-Weed frequency -Weed biomass		Average number of weed species per field	21* (175)	12** (100)
						Density	519 (324)	Sprayed: 160 (100)
						Frequency vs. 1997-1999 survey	Fumaria officinalis increased	Galium spurium increased
						Weed biomass	775 kg ha^{-1} (464)	167 kg ha^{-1} (100)
						Weed biomass 2	Elymus repens, the most frequent and abundant grass species, produced the highest proportion (about 30%) of the total weed biomass in both cropping systems.	
						* the most frequent species were Chenopodium album 96%, Stellaria media 94%, Viola arvensis 94% and Elymus repens 89%. ** the most frequent weed species were Viola arvensis 83%, Stellaria media 65%, Galeopsis spp. 59% and Galium spurium 59%.		
	The occurrence of weeds was assessed in late July-early August. Altogether 148 weed species were identified, of which 128 were broad-leaved and 20 grass species CONV: Weeds in conventional cropping were effectively controlled with available herbicides ORG: weed management in organic cropping calls for urgent measures such as direct mechanical weed control in crop stands, which was not practised at all in survey fields.							

Study	**Location of study**	**Study type**	**Study design**			**Key results**		
			Explanatory variable («x»)	Response variable («y»)	Statistical analysis			
Salonen, J., et al. 2013	Finland	Survey(s) Comparing the surveys from 1997-1999 and 2007-2009 The same 382 fields were assessed during both decades.	Spring cereals ORG: survey 1 vs. survey 2 CONV: survey 1 vs. survey 2	-Weed number -Weed frequency -Weed biomass			Survey 1: <u>1997-1999</u>	Survey 2: <u>2007-2009</u>
						Conventional a	The total abundance of weeds has remained at about the same level as recorded in the late 1990s	
						Conventional b	Overwintering weed species like *Galium spurium, Lamium* spp., *Lapsana communis* and *Poa annua* have become more frequent, indicating a trend towards reduced primary tillage. Increased use of glyphosate has in turn led to a decline in *Elymus repens*, particularly in non-ploughed fields.	
						Organic a	Substantially <u>increased total biomass</u> of weeds was associated with organic cropping,. (The opposite trend was apparent in the fields, which had returned from organic farming back to conventional cropping).	
						Organic b	Reason (a): Due to lack of direct weed control methods and inadequate crop competition.	
	<u>General conclusion:</u> The results suggest that more decisive IPM strategies are required, both in organic cropping to stop the increasing weed biomass and in conventional cropping to reduce current reliance on herbicides.							
Andreasen, C. & JC Streibig 2010 Weed research (found in #42)						Changes in weed flora in arable fields of Nordic		

Study	Location of study	Study type	Study design			Key results
			Explanatory variable («x»)	Response variable («y»)	Statistical analysis	
70 (#43)						countries: Organic agriculture not included in the review!
Sjursen, H. 2001	Norway	Field experiment	Crop rotation 6yr (annual crops, 3 yr. grass-cover ley) ORG	-Weed number -Weed biomass -Seed bank		ORG Annual crops: High frequency of weeds Increasing seed bank ley: Decreasing flowering weeds = Decreasing Seed bank: halved after 3 yr. Perennial weeds seeds: 2-3 % of the seed bank
Tamis, W. L. M. and W. J. van den Brink 1999	Netherlands	Survey	Winter wheat -ORG -CONV -INT	Description of various aspects connected to CONV, INT and ORG Most focus on methods		
	CONV / INT: At both conventional and integrated farms there is an ongoing intensification of fertilizer and pesticide use. Management at 'integrated' farms is consequently increasingly similar to that at conventionally managed holdings. ORG: The organic farms differ in virtually every aspect of their management, and their management regime shows little variation over time. ORG: At the organic farms seeding takes place about 4–5 weeks later than on conventional farms Mechanical weed control: On average over the years, mechanical weeding is employed from two (A2000) to four times (IP) on integrated holdings to eight times more often on organic holdings, compared with conventional holdings					
Tamm, I., et al.	Estonia	Field exp.(s)	Spring cereals (wheat, barley,	-Weed number		ORG | CONV

Study	Location of study	Study type	Study design			Key results			
			Explanatory variable («x»)	Response variable («y»)	Statistical analysis				
2009		2005-2008	oat) -ORG -CONV Thirteen varieties of each crop tested out	-Weed biomass NB: The plots were harrowed twice, pre + post emerg. weed harrowing		Yield, oat	4050 kg ha^{-1} (90)	4500 kg ha^{-1} (100)	
						Yield, wheat	3450 kg ha^{-1} (66)	5227 kg ha^{-1} (100)	
						Yield, barley	2990 kg ha^{-1} (64)	4672 kg ha^{-1} (100)	
						Number of weeds* Oat Barley Wheat	 100a 142b 138b		
						Biomass of weeds** Oat Barley Wheat	 48a 80b 84b		
						*m^{-2} **g (DW) m^{-2}			
	-Oat as the most unpretentious crop was the highest yielding in organic trial and had the best weeds suppressing ability among the spring cereals. The most widely spread weeds were (Chenopodium album) and (Viola arvensis). -Yielding level of spring cereals in organic conditions was largely influenced by the **precrop** and **weather conditions**. In the first trial year after the favourable precrop (red clover) and favourable weather conditions all the cereals produced yields higher than 4500 kg ha^{-1}. -In spite of two harrowings the number of weeds per m² was quite high although their biomass under the cereals suppression was not high.								
Ulber, L., et al. 2009	Germany	Survey (?) 24 winter	Crop Rotation / Winter wheat -ORG	-Weed species richness -Cover -Community composition			ORG	CD	CS
						Weed sp. Richness	highest	Did not differ	

Study	Location of study	Study type	Study design			Key results	
			Explanatory variable («x»)	Response variable («y»)	Statistical analysis		
		wheat fields 'On-farm approach'	-CONV. diverse (CD)* -CONV. Simple (CS)* *Crop rotations And and weed control (with vs. without)	-Crop biomass Weed species with beneficial functions for invertebrates and birds were analysed separately.		Weed sp. Richness 2	Weed control treatment reduced species richness in both conventional rotations, but not in the organic one
	- Results from the study indicate that the maintenance of weed species richness and conservation of species with important ecological functions requires not only temporal diversification of crop species in the rotation, but also an adjustment of weed control strategies.						
Walsh, C. S., et al. 2011	x	x	Apple & Asian pear -ORG -CONV	x	x	Different climate: "in a hot, humid climate"	

6.4 NEMATODES

Table 8. Results from included studies on nematodes

STUDY	LOCATION	STUDY TYPE	CULTIVATION SYSTEM	PARAMETERS MEASURED	KEY RESULTS
Berkelmans *et al.* 2003	California, Davis, U.S.A.	Field Split plot design with 4 management treatments as main plots randomized in 4 blocks, and rotation crops as sub plots randomized in main plots. Sub plot size 0.13 ha.	Conventional *Tomato-safflower-corn-wheat/beans* *Winter-fallow* *Synthetic fertilizer* Low-input *Tomato-safflower-corn-purpule vetch mixed with oats (winter cover crop).* *Synthetic fertilizer* Organic *Tomato-safflower-corn-purpule vetch mixed with oats (winter cover crop).* *Composted poultry manure*	2,5 x 30 cm Abundance of nematodes	Main contribution to difference between management types was *Pratylenchus* and *Tylenchorhynchus*. *Pratylenchus* more numerous in conv. compared to Low and org. *Tylenchorhynchus* more numerous in low and org after 1995 (last 3 yrs.). Bacterial feeding nematodes were more prevalent in org and low than in conventional…….more plant biomass plowed down in org and low. Crops more important for the nematode community than management type. *Pratylenchus thornei* became more dominant with years, but suppressed in org and low. *Tylenchorhynchus*, which became more prominent in org and low have wide host ranges on grasses and legumes used in org and low. The nematode community responds within a few years to a change in farming system to stabilize.
Birkhofer *et al.* 2008	Thervil, Switzerland	Field long-term agricultural experiment Wheat	Conventional vs. organic; Stockless vs. mixed	Abundance	Bacterivorous, herbivorous and omnivorous nematodes twice as abundant in BIODYN and BIOORG compared to COMIN; the opposite was true for fungivorous nematodes.

STUDY	LOCATION	STUDY TYPE	CULTIVATION SYSTEM	PARAMETERS MEASURED	KEY RESULTS
		5 x 20 m plots	Conventional with livestock vs. organic Stockless conventional vs. mixed Organic farming compost vs. organic rotted farmyard manure		*Comm: All is on the group-levels….5 cm depth is too superficial.*
Briar *et al.* 2007	Wooster, Ohio, U.S.A.	Field 18 x 18 m plots; corings 5 x 15 cm	Long-term transition from conventional to organic management. Conventional: corn-soybean rotation; Organic: corn-soybean-oats/hay (red clover and timothy)	Abundance genus – species level	Bacterivotous nematodes sign. more abundant in organic farming systems. First year plant parasitic nematodes were more abundant in conventional…but later no sign diff.; after 4 yrs *Pratylenchus crenatus* sign more abundant in conventional; year 4 Soya> Timothy as host for *P. crenatus*. During the 4 yrs. Omnivores, Predators and total plant parasitic nematodes decrease in numbers, bacterivorous and mychophagous nematodes oscillate, while *P. crenatus* increases. Sign suppression of *P. crenatus* in organic may relate to the inclusion of hay in the rotation. Comm: *Small samples long extraction (72 hrs).*
Coll *et al.* 2012	Southern France	Field 24 commercial vineyard plots.	10 plots conventional and the rest organic; org 7, org 11 and org 17.	Nematode numbers with resolution on trophic groups and genera.	Bacterivorous and facultative plant feeders most abundant trophic groups in both types of management; organic plots higher density of obligate plant feeders (*Paratylenchus* and *Tylenchorhynchus*). Organic plots significantly more *Pratylenchus* than conventional; Occasionally *Helicotylenchus* spp were abundant. No difference for bacterial feeders. *Panagrolaimus* more abundant in organic. Grass cover may have allowed plant feeders to reach high densities in organic soils. More fungal feeders in organic than conventional. More omnivors in organic than conventional. No significant difference for Mononchidae between management groups.

STUDY	LOCATION	STUDY TYPE	CULTIVATION SYSTEM	PARAMETERS MEASURED	KEY RESULTS
Ferris *et al.* 1996	California, U.S.A.		Organic and conventional tomato in 4 years rotation.	Nematode numbers with resolution on trophic groups, genus and species.	More nematodes in conventional than organic early in season. Numbers of plant parasitic nematodes and omnivores similar in both systems. There was no clear pattern in difference in numbers of abundant plant parasitic nematodes between systems
Neher 1999	North Carolina U.S.A.	Field	8 yrs. Organic(org) vs. conventional(conv). Org 1 (mixed vegetables, herbs and grass cover crop); Conv1 (pumpkin); Org 2 (mixed vegetables, cut flowers, rye/crimson clover cover crop); Conv 2 (mixed vegetables) Org 3. (Mixed vegetables, cut flowers); Conv 3 (Field corn, orchardgrass clover cover crop/?; Org 4 (Mixed greens, asparagus, oat cover crop); Conv. 4 (Field corn, cereal rotation); Org 5. Mixed greens, oat, rye, crimson clover cover crop.	Nematode numbers with resolution on trophic groups and family level.	Bacterivorous and plant parasitic nematodes most abundant trophic groups in both types of management, and both groups reached higher densities in organic than conventional soils. Higher abundance of Criconematidae and Heteroderidae in organic soils *Comm: Crop species was not considered, nor the species of nematodes. This decreases the value of the study.*
Okada *et al.*	Yamagata	Green house 24	Precrop tomato for	Nematode	No difference for bacterial feeders between org and conv. Predator +

STUDY	LOCATION	STUDY TYPE	CULTIVATION SYSTEM	PARAMETERS MEASURED	KEY RESULTS
2009	and Fukushima, Tohoku, Japan		majority of plots; Organic vs. conventional tomato	numbers with resolution on trophic groups and genera	omnivore group more abundant in organic compared to conventional. Higher abundance of obligate root feeders in conventional compared to organic was not sign. No difference for fungal + fac. root feeders. *Comm:* *No quantitative data for obligate root feeders.*
Tsiafouli *et al*. 2006.	Thessaloniki Greece	Field	Organic and conventional 7 years cultivation of *Asparagus officinalis*	Nematode numbers with resolution on trophic groups and genera.	Bacterivorous nematodes more abundant in organic, while plant feeders were more abundant in conventional. Dominance of *Helicotylenchus* (40 %) in conventional, but only 1 % in organic. *Comm:* *Interesting that Paratylenchus formed 8 %, i.e. being the dominating plant parasitic nematode genus*.

7 Appendix 2B - Data extracted from included studies on content of nutrients

7.1 FRUIT

Table 9. **Results from included studies on quality and nutritional aspects in fruits (apple, pear, plum, sour cherry).**

Study	Location of study	Study type	Study design			Key results
			Forklaringsvariabler: *Cultivating system (organic/ecological/ biodynamic and conventional /integrated), type vekst, antall sorter/kultivarer, antall år, etc.*	*Målevariabler:* *Relevant parameters measured (innhold av næringsstoffer, tungmetaller, omfang av sykdomsangrep, antall skadegjørere, etc,)*	*Statistical analysis* *(navn på metode)*	
Nagy PT, Biro T, Nyeki J, Szabo Z, 2013	Hungary	Field trial	2 years, organic and integrated growing of apples (cvs. 'Rewena', 'Retina' and 'Reanda')	Acid and sugar content	One-way and two-way ANOVA, Duncan's multiple-range test	Significant effects of year, cultivar, and production system on vitamin C content. Concentrations of sugars (except sucrose) were not significantly affected by production system. Effect of cultivar showed to be stronger than production system.
Bat KB, Vidrih R, Necemer M, Vodopivec BM, Mulic I, Kump P et al., 2012	Slovenia	Field trial	Apple (cvs. 'Topaz', 'Idared', 'Golden Delicious', 'Goldrush', 'Gala', 'Gloster') from ecological or conventional production systems	Soluble solids, ascorbic acid, antioxidant activity, total phenols, trace elements (P, S, Cl, Ca, K, Mn, Fe, Cu, Ni, Zn, Br, Rb)	Mean values, standard deviation (SD), Kruskal-Wallis test, LDA multivariate analysis (linear discriminant analysis)	Significantly higher vitamin C, S and Ca content in organically than conventionally grown apples
Holb IJ, Dremak P, Bitskey K, Gonda I, 2012	Hungary	Field trial	Apple (10 cvs.) grown in integrated and organic production systems	Soluble solids, Ca content	Split-plot analysis of variance, LSD-test	Soluble solid and Ca contents were significantly higher in organic vs. integrated apples for one year only.

Study	Location of study	Study type	Study design			Key results
			Forklaringsvariabler: *Cultivating system (organic/ecological/ biodynamic and conventional /integrated), type vekst, antall sorter/kultivarer, antall år, etc.*	*Målevariabler:* *Relevant parameters measured (innhold av næringsstoffer, tungmetaller, omfang av sykdomsangrep, antall skadegjørere, etc,)*	*Statistical analysis* *(navn på metode)*	
Jakobic J, Slatnar A, Stampar F, Veberic R, Simoncic A, 2012	Slovenia	Field trial	Apple (cv. 'Golden Delicious') grown in four production systems (organic, integrated and two combined systems)	Primary metabolites (colour, sugars, organic acids) and phenolic profile	ANOVA, Duncan's test	Organically produced apples were significantly firmer, but had lower values of some of the colour parameters (a*, h^o and L) compared to the non-organic systems. Skin from organic apples were significantly higher in hydroxycinnamic acids, flavan-3-ols and dihydrocalchones, while apple pulp from organic apples had significantly higher concentration of flavan-3-ols, flavonols and total phenolic content.
Jørgensen H, Bach Knudsen KE, Lauridsen C, 2012	Denmark	Field trial	2 years, apple (cv. 'Ottawa') grown organically and conventionally	Carbohydrate and lipid composition	ANOVA, GLM	No significant effects of the cultivation systems were found.
Konopacka D, Kaczmarek U, Matulska A, Wawrzynczak A, Kruczynska D, Rutkowski KP, 2012	Poland	Field trial	Apple (cv. 'Topaz') grown organically and integrated	Firmness, titratable acidity, soluble solids	ANOVA	Organic apples had significantly higher titratable acidity levels. No significant effect of growing system on quality traits connected with aroma compounds was found.
Nagy PT, Nyéki J, Szabo Z 2012	Hungary	Field trial	2 years, apple (cvs. 'Idared', 'Rewena', 'Reanda', 'Retina') grown organically and integrated	Organic acids (malic and citric acids), sugars, ascorbic acid	ANOVA, Duncan's significante difference test	No significant differences were found between the growing systems on organic acids or ascorbic acid content. Glucose and fructose content were significantly higher in apples

Study	Location of study	Study type	Study design			Key results
			Forklaringsvariabler: *Cultivating system (organic/ecological/ biodynamic and conventional /integrated), type vekst, antall sorter/kultivarer, antall år, etc.*	*Målevariabler:* *Relevant parameters measured (innhold av næringsstoffer, tungmetaller, omfang av sykdomsangrep, antall skadegjørere, etc,)*	*Statistical analysis* *(navn på metode)*	
						grown organically than integrated.
Adamczyk MJ, Kostyra E, Wasiak-Zys G, Hallmann E, Batorska D, Rembialkowska E, 2010	Poland	Field trial	3 years, apple (cvs. 'Red Booskop', 'Lobo', 'Jonagold'), grown organically and conventionally	Soluble solids, total sugars, reducing sugars, titratable acidity	ANOVA, Tukey's test	For all cultivars, organically grown apples had significantly higher content of soluble solids, total and reducing sugar compared to conventional apples. Significantly higher titratable acidity in organic apples was found in the cv. 'Red Booskop' only.
Bertazza G, Cristoferi G, Bignami C, 2010	Italy	Field trial	2 years, apple (cv. 'Golden Delicious') and pear (cv. 'Abate Fétel) grown organically and conventionally	Dry matter, sugars, organic acids, ascorbic acid, pigments, polyphenols, tocopherols	t-test	Dry matter content was significantly lower in conventional pears in 2002 and in conventional apples in 2003. Total sugar content was higher in organic fruits, except for apple in 2002. Significantly higher content of total polyphenols in pears and ascorbic acid in both apples and pears grown organically. Tocopherol levels were higher in organic apples and in conventional pears. Conventional pears had higher levels of carotenoids compared with organic products, whereas apples showed an opposite trend.
Esch JR, Friend JR, Kariuki JK, 2010	Canada	Basket	Apple (cvs. 'Gala', 'Red Delicious') grown conventionally and organically	Ascorbic acid	t-test	No significant differences between the two growing systems were found.

Study	**Location of study**	**Study type**	**Study design**			**Key results**
			Forklaringsvariabler: *Cultivating system (organic/ecological/ biodynamic and conventional /integrated), type vekst, antall sorter/kultivarer, antall år, etc.*	*Målevariabler:* *Relevant parameters measured (innhold av næringsstoffer, tungmetaller, omfang av sykdomsangrep, antall skadegjørere, etc,)*	*Statistical analysis* *(navn på metode)*	
Jönsson Å, Nybom H, Rumpunen K, 2010	Sweden	Field trial	3 years, apple (cvs. 'Aroma', 'Karin Schneider') grown organically and integrated	Micronutrients, sugars, malic acid	Non-parametric methods (due to lack of distribution of the data). Mann-Whitney U-test. One-way ANOVA, Tukey's test.	N and B contents were higher in the integrated apples compared with organic, in addition to Cu in the last trial year. Treatment had little impact on colour, firmness, sugar content and malic acid.
Mikulic Petkovsek M, Slatnar A, Stampar F, Veberic R, 2010	Slovenia	Field trial	2 years, apple (cvs. 'Florina', 'Topaz', 'Crown Prince Rudolf', 'Reinette de Champagne') grown organically and integrated	Phenolic compounds, total phenolics, antioxidant capacity	ANOVA, Student's t-test, multivariate statistical analysis (hierarchial cluster analysis, discriminate analysis and classification)	Organic apples had higher content of hydroxycinnamic acids, flavanols, dihydrochalcones, quercetins and total phenolics than apples from integrated cultivation.
Nagy-Gasztonyi M, Sass-Kiss A, Tomoskozi-Farkas R, Banati D, Daood HG, 2010	Hungary	Field trial	Sour cherry (cvs. 'Kantorjanosi', 'Ujfehertoi fürtös', 'Debreceni bőtermő') grown organically and conventionally	Phenolic compounds	ANOVA	Cultivation system had no significant effect on the phenolic compounds in the fruits.
Peck G, Merwin I, 2010	USA	Field trial	4 years, apple (cv. 'Liberty') grown organically and integrated	Starch, firmness, soluble solids, titratable acidity, pH, total antioxidant	PROC MIXED	No significant differences on fruit firmness, soluble solids, pH, titratable acidity, total antioxidant and total phenolic content were found.

Study	Location of study	Study type	Study design			Key results
			Forklaringsvariabler: *Cultivating system (organic/ecological/ biodynamic and conventional /integrated), type vekst, antall sorter/kultivarer, antall år, etc.*	*Målevariabler: Relevant parameters measured (innhold av næringsstoffer, tungmetaller, omfang av sykdomsangrep, antall skadegjørere, etc,)*	*Statistical analysis* *(navn på metode)*	
				and total phenolic content		
Soria Y, Schotsmans W, Reig G, Larrigaudiere C, 2010	Spain	Field trial	Apple (cvs. 'Golden Delicious', 'Fuji Kiku-8') grown organically and integrated.	Colour, firmness, titratable acidity, soluble solids	ANOVA, GLM	Production system had significant effect on some of the quality characteristics, dependent on apple cultivar tested.
Peck GM, Merwin IA, Watkins CB, Chapman KW, Padilla-Zakour OI, 2009	USA	Field trial	4 years, apple (cv. 'Liberty') production system transited from conventional to integrated and organic systems	Starch, firmness, soluble solids, titratable acidity, dry matter, skin colour, total phenolic content and antioxidant capacity, micronutrients	PROC MIXED	No significant effects of growing systems was found, except for K for two years and Ca for four years, where higher concentration was found in apples grown integrated
Roussos PA, Gasparatos D, 2009	Greece	Field trial	Apple (cv. 'Starking Delicious') grown organically and conventionally	Fruit colour, dry matter, soluble solids, titratable acidity, pH, phenolic compounds, nutrients (N, K, Ca, Na, Mn).	Student's t-test	Conventionally produced apples showed higher total flavonoid and o-diphenols concentration, while pulp only had higher flavonoid content. N concentration was higher in conventionally grown fruits, while K, Ca, Na and Mn concentrations were higher in pulp of organically produced fruits.

Study	Location of study	Study type	Study design			Key results
			Forklaringsvariabler: *Cultivating system (organic/ecological/ biodynamic and conventional /integrated), type vekst, antall sorter/kultivarer, antall år, etc.*	*Målevariabler: Relevant parameters measured (innhold av næringsstoffer, tungmetaller, omfang av sykdomsangrep, antall skadegjørere, etc,)*	*Statistical analysis* *(navn på metode)*	
Stracke BA, Rufer CE, Bub A, Seifert S, Weibel FP, Kunz C et al., 2009	Switzerla nd	Field trial	3 years, apple (cv. 'Golden Delicious') grown organically and conventionally	Firmness, minerals, soluble solids, dry matter, polyphenols, antioxidant capacity	ANOVA, Tukey-Kramer post hoc test	For two years, antioxidant capacity was higher in organically compared to conventionally produced fruits. For one year, significantly higher polyphenol concentrations were found in organically grown apples.
Valavanidis A, Vlachogianni T, Psomas A, Zovoili A, Siatis V, 2009	Greece	Field trial	Apple (cvs. 'Red Delicious-Starking', 'Golden Delicious', 'Granny Smith', 'Jonagold', 'Royal Gala') grown organically and conventionally	Total and individual polyphenols, total antioxidant activity	ANOVA, Kolmogorov-Smirnov and Levene's tests	Growing practice had no significant influence on total phenolic compounds. Growing system affected antioxidant activity and some phenolic compounds for some cultivars.
Lamperi L, Chiuminatto U, Cincinelli A, Galvan P, Giordiani E, Lepri L et al., 2008	Italy	Field trial	Apple (cvs. 'Annurca', 'Golden Delicious', 'Red Chief', ' Stayman Neepling') grown organically and integrated	Polyphenols, free radical scavenging activity (antiradical activity)	ANOVA, Tamhane test	For two of the cultivars ('Annurca' and 'Golden Delicious'), cultural practice had no significant effect on polyphenol content or antiradical activity. When analyzing peel only, organic apples had higher antiradical activity compared to integrated produced apples.
Briviba K, Stracke BA, Rufer CE, Watzl B, Weibel FP, Bub A, 2007	Switzerla nd	Field trial	Apple (cv. 'Golden Delicious') grown organically and conventionally	Phenolic compounds (chlorogenic acid, hydroxycinnamates, flavanols, dihydrochalcones,	StatView SAS, Student's t-test	No significant differences were found of the agricultural methods applied

Study	Location of study	Study type	Study design			Key results
			Forklaringsvariabler: *Cultivating system (organic/ecological/ biodynamic and conventional /integrated), type vekst, antall sorter/kultivarer, antall år, etc.*	*Målevariabler:* *Relevant parameters measured (innhold av næringsstoffer, tungmetaller, omfang av sykdomsangrep, antall skadegjørere, etc,)*	*Statistical analysis* *(navn på metode)*	
				flavonols)		
Reig G, Larrigaudiere C, Soria Y, 2007	Spain	Field trial	Apple (cvs. 'Fuji', 'Golden Delicious') grown organically and conventionally	Colour, firmness, acidity, soluble solids, titratable acidity, antioxidant activity, ascorbic acid	Enterprise Guide V2, Duncan's test mean separation	Organic apples were significantly firmer, had higher titratable acidity and soluble solid content. Organic grown 'Fuji' apples were significantly higher in ascorbic acid. Growing system had no effect on total antioxidant activity.
Roth E, Berna A, Beullens K, Lammertyn J, Schenk A, Nicolai B, 2007	Belgium	Field trial	Apple (cv. 'Jonagold') grown organically and integrated	Acoustic stiffness, firmness, soluble solids, sugar and acid content, aroma profile	Mixed Model (SAS), PCA	No significant effects of the two different production systems were observed.
Hecke K, Herbinger K, Veberic R, Trobec M, Toplak H, Stampar F et al., 2006	Austria	Field trial	Apples grown organically (11 cvs.) and integrated (7 cvs.)	Sugar-, acid- and phenolic content	GLM	Higher content of phenolic and malic acid content was found in organically grown apple cultivars, whereas for sugar content, no significant differences were detected.
Peck GM, Andrews PK, Reganold JP, Fellman JK, 2006	USA	Field trial	10 years, apple (cv. 'Gala') grown organically, conventionally and integrated	Firmness, starch, soluble solids, titratable acidity, volatile esters, total antioxidant activity	ANOVA, Fischer's LSD	No significant effect by farm management system was found, except for antioxidant activity, where organic apples were compared to integrated and conventional practice.

Study	Location of study	Study type	Study design			Key results
			Forklaringsvariabler: *Cultivating system (organic/ecological/ biodynamic and conventional /integrated), type vekst, antall sorter/kultivarer, antall år, etc.*	*Målevariabler:* *Relevant parameters measured (innhold av næringsstoffer, tungmetaller, omfang av sykdomsangrep, antall skadegjørere, etc,)*	*Statistical analysis* *(navn på metode)*	
Roth E, Berna AZ, Beullens K, Schenk A, Lammertyn J, Nicolai B, 2005	Belgium	Field trial	Apple (cv. 'Jonagold') grown in organic and integrated orchards in three different production regions.	Quality (texture and flavor) after harvest and additional storage for six months in NA and CA.	PCA	There was no difference between fruits coming from organic and integrated production systems.
Veberic R, Trobec M, Herbinger K, Hofer M, Grill D, Stampar F, 2005	Austria and Slovenia	Field trial	Apple (11 cvs.) grown organically and integrated	Phenolic compounds	ANOVA, LSD, Duncan's test	Growing system did not significantly affect phenolic compounds in apple peel. Organically grown apples, however, exhibited a higher content of phenolic substances in pulp compared to integrated grown apple cultivars.
Bertschinger L, Mouron P, Dolega E, Hohn H, Holliger E, Husistein A et al., 2004	Switzerla nd	Field trial	Apple (cvs. 'Resi', 'Idared', 'Booskop') grown organically and integrated	Firmness	LSD-test	Organic growing resulted in significantly firmer apples in one of the cultivars tested ('Resi')
Lombardi-Boccia G, Lucarini M, Lanzi S, Aguzzi A, Cappelloni M, 2004	Italy	Field trial	Plum (cv. 'Shiro') grown organically and conventionally	Minerals, dietary fiber, carbohydrates, organic acids, ascorbic acid, vitamin E, β-carotene, phenolics (total polyphenols,	ANOVA, Student's t-test	Organically grown plums were significantly higher in K, Mg, Zn and β-carotene compared to conventional cultivation, but the opposite for Na and Cu. No significant effect of cultivation on fiber or total sugar content was observed. Growing system had no significant effect on the ascorbic acid content or vitamin

Study	Location of study	Study type	Study design			Key results
			Forklaringsvariabler: *Cultivating system (organic/ecological/ biodynamic and conventional /integrated), type vekst, antall sorter/kultivarer, antall år, etc.*	*Målevariabler:* *Relevant parameters measured (innhold av næringsstoffer, tungmetaller, omfang av sykdomsangrep, antall skadegjørere, etc,)*	*Statistical analysis* *(navn på metode)*	
				phenolic acids, flavonols)		E, except for γ-tocopherol, where higher content was observed inconventional grown plums. This was also the case with vitamin K. Total content of polyphenols and quercetin was higher in conventional plums. On the contrary, myricetin and kaempferol content was higher in organic grown plums.
Balas J, 2003	Austria	Field trial	Pear (cvs. 'Beurre Bosc's', 'Packham's Triumph', 'Concorde') grown organically and integrated	Brix, pH, dry matter	Statgraphics for Windows 2.0	No significantly effects of growing systems were found
Carbonaro M, Mattera M, Nicoli S, Bergamo P, Cappelloni M, 2002	Italy	Field trial	3 years, pear (cv. 'Williams') grown organically and conventionally	Ascorbic acid, citric acid, polyphenols	ANOVA, Student's t-test	Significantly higher content of phenolic compounds was found in organically grown pears. No significant differences in content of ascorbic or citric acid in the two growing systems was found.
Andrews PK, Fellmann JK, Glover JD, Reganold JP, 2001	USA	Field trial	2 years, apple (cv. 'Golden Delicious') grown organically, integrated and conventionally	Firmness, soluble solids, acidity, N, P, K, Mg, Ca, B	LSD test	For one year, organically grown apples were significantly firmer than apples produced in a conventional or integrated system. Production system did not affect the content of soluble solids significantly, but apples grown conventionally had significantly higher acidity content than apples grown organically or integrated. N and B in fruits were significantly

Study	**Location of study**	**Study type**	**Study design**			**Key results**
			Forklaringsvariabler: *Cultivating system (organic/ecological/ biodynamic and conventional /integrated), type vekst, antall sorter/kultivarer, antall år, etc.*	*Målevariabler: Relevant parameters measured (innhold av næringsstoffer, tungmetaller, omfang av sykdomsangrep, antall skadegjørere, etc,)*	*Statistical analysis* *(navn på metode)*	
						lower in organic fruits in 1998. N, P and B concentration was significantly lowest in organic grown fruits in 1999.
Weibel FP, Bickel R, Leuthold S, Alfoldi T, 2000	Switzerland	Field trial	Apple (cv. 'Golden Delicious') grown organically and integrated	Firmness, sugar, malic acid, mineral elements, phenolics, selenium, fibres, vitamin C, vitamin E	ANOVA, Tukey's test	Organically grown apples had significantly firmer fruit flesh, higher P and phenolic content compared to apples grown conventionally

7.2 Berries

Table 10. Results from included studies on quality and nutritional aspects in berries (strawberry, raspberry, black and red currant).

Study	Location of study	Study type	Study design			Key results
			Forklaringsvariabler: *Cultivating system (organic/ecological/ biodynamic and conventional /integrated), type vekst, antall sorter/kultivarer, antall år, etc.*	*Målevariabler:* *Relevant parameters measured (innhold av næringsstoffer, tungmetaller, omfang av sykdomsangrep, antall skadegjørere, etc,)*	*Statistical analysis* *(navn på metode)*	
Wojdylo A, Oszmianski J, Milczarek M, Wietrzyk J, 2013	Poland	Field trial	Black and red currant (cvs. 'Ben Hope', 'Ben Alder', 'Titania', 'Rondom') - effect of cultivation system (organic and conventional)	Phenolic profile, antioxidant activity, ascorbic acid	ANOVA, Duncan's test	Significant differences between organic and conventional cultivation system was found for polyphenols, vitamin C and antioxidant activity.
Kristl J, Krajnc AU, Kramberger B, Mlakar SG, 2013	Slovenia	Field trial	Strawberry (cvs. 'St. Pierre', 'Elsanta', 'Sugar Lia', 'Thuchampion') grown organically and conventionally	Mineral content (P, K, Mg, Fe, Zn, Cu, and Mn), antioxidant activity	ANOVA, Duncan's multiple-range test	Organically grown fruits had higher antioxidant activity and Cu content than the conventional fruits, while conventional grown fruits were higher in P, K, Mg, Fe and Mn.
Crecente-Campo J, Nunes-Damaceno M, Romero-Rodriguez MA, Vazquez-Oderiz ML, 2012	Spain	Field trial	Strawberry grown under organic and conventional farming systems	Colour, anthocyanins, ascorbic acid, total phenolic content	Student's t-test	The color of the organic fruits was darker, redder and less vivid, with significantly higher levels of anthocyanins and ascorbic acid. Cultivation system did not affect the total phenolic content.
Fernandes VC, Domingues VF, Freitas Vd, Delerue-Matos	Portugal	Field trial	3 years, strawberry (cvs. 'Siba', 'Camarosa', 'Festival', 'San Andreas') grown organically and	Phenolic compounds, antioxidant activity	Unpaired two tailed t-test with Welch correction	Total phenolic content, anthocyanins and antioxidant activity were higher in organically grown berries.

Study	Location of study	Study type	Study design			Key results
			Forklaringsvariabler: *Cultivating system (organic/ecological/ biodynamic and conventional /integrated), type vekst, antall sorter/kultivarer, antall år, etc.*	*Målevariabler:* *Relevant parameters measured (innhold av næringsstoffer, tungmetaller, omfang av sykdomsangrep, antall skadegjørere, etc,)*	*Statistical analysis* *(navn på metode)*	
C, Mateus N, 2012			integrated			
Jin P, Wang SY, Gao H, Chen H, Zheng Y, Wang CY, 2012	USA	Field trial	Red raspberry (cv. 'Estes') grown organically and conventionally	Antioxidant capacity, flavonoids, total phenolics, total anthocyanins	SPSS, Duncan's multiple range tests	Raspberries grown organically had significantly higher antioxidant capacity than those produced conventionally.
Roussos PA, Triantafillidis A, Kepolas E, 2012	Greece	Field trial	Strawberry (cv. 'Camarosa') grown in a organic, conventional and integrated system	Dry matter, colour, firmness, titratable acidity, total soluble solids, pH, antioxidant capacity	ANOVA, Tukey's test	No significant differences were found between the three farming systems concerning pH, titratable acidity, firmness, colour parameters or antioxidant activity. Organically and integrated produced fruits showed significantly higher values of total soluble solids than conventional practice.
Jin P, Wang SY, Wang CY, Zheng YH, 2011	USA	Field trial	Strawberry (cvs. 'Earliglow', 'Allstar') grown organically and conventionally	Antioxidant activity, flavonoids	SPSS, Duncan's multiple-range tests	Organic strawberries had significantly higher antioxidant activity and flavonoid content than conventional produced berries.
Skupien K, Ochmian I, Grajkowski J, Krzywy-Gawronska E, 2011	Poland	Field trial	Red raspberry (cvs. 'Polka', 'Polana', 'Pokusa' grown organically or conventionally	Dry weight, soluble solids, acidity, total sugars, vitamin C, phenolics, antioxidant activity	One-way ANOVA, Tukey's test	No significant effects of production system were observed for any of the quality variables tested.

Study	Location of study	Study type	Study design			Key results
			Forklaringsvariabler: *Cultivating system (organic/ecological/ biodynamic and conventional /integrated), type vekst, antall sorter/kultivarer, antall år, etc.*	*Målevariabler:* *Relevant parameters measured (innhold av næringsstoffer, tungmetaller, omfang av sykdomsangrep, antall skadegjørere, etc,)*	*Statistical analysis* *(navn på metode)*	
Baiamonte I, Raffo A, Nardo N, Paoletti F, Bonoli M, Baruzzi G et al., 2010	Italy	Field trial	2 years, strawberry (cvs. 'Redcord', 'Nora') grown organically and integrated	Anthocyanin compounds	ANOVA, Duncan's test	For both cultivars, total anthocyanin content varied significantly between the two production systems, years and even between cultivars, showing a non-uniform behavior.
D'Evoli L, Tarozzi A, Hrelia P, Lucarini M, Cocchiola M, Gabrielli P et al., 2010	Italy	Field trial	Strawberry (cv. 'Favette') grown in biodynamic and conventional systems	Ascorbic acid, ellagic acid, anthocyanins, flavonols, antioxidant activity	Student's t-test, Dunnett's post hoc test, Pearson's correlation coefficient	Compared to conventional strawberries, biodynamic fruits had significantly higher content of ascorbic acid, pelargonidin-3-glucoside, cyanidin-3-glucoside, ellagic acid, quercetin and kaempferol. Antioxidant activity of biodynamic strawberry was significantly higher than that of the conventional one.
Kahu K, Klaas L, Kikas A, 2010	Estonia	Field trial	3 years, strawberry (cvs. 'Bounty', 'Polka', 'Korona', 'Senga Sengana') grown in organic and conventional fields	Berry quality, soluble solids, ascorbic acid	Two-way ANOVA	For two years, organically grown strawberries had significantly higher content of soluble solids, but significantly lower content of ascorbic acid comparing with conventionally grown strawberries.
Sablani SS, Andrews PK, Davies NM, Walters T, Saez H, Syamaladevi RM et al., 2010	USA	Field trial	Red raspberry (cv. 'Meeker') grown organically and conventionally in two different fields	Total anthoyanins, total and individual phenolic compounds, total antioxidant activity	ANOVA, Fisher's least significant difference (LSD)	Total anthocyanin, phenolic compounds and antioxidant activity varied significantly between the two production systems. In one field, total anthocyanin content was significantly lower in organic than conventional berries, for total phenolics, significantly higher concentration was found

Study	Location of study	Study type	Study design			Key results
			Forklaringsvariabler: *Cultivating system (organic/ecological/ biodynamic and conventional /integrated), type vekst, antall sorter/kultivarer, antall år, etc.*	*Målevariabler:* *Relevant parameters measured (innhold av næringsstoffer, tungmetaller, omfang av sykdomsangrep, antall skadegjørere, etc,)*	*Statistical analysis* *(navn på metode)*	
						in organic berries, while for total antioxidant activity, berries in one field showed significantly higher activity in organically fruits, but the other field lower, compared to conventionally produced fruits.
Tarozzi A, Cocchiola M, D'Evoli L, Franco F, Hreila P, Gabrielli P et al., 2010	Italy	Field trial	Strawberry (cv. 'Favette') grown in conventional and biodynamic agriculture methods	Phenolic acids, flavonols, antioxidant capacity	One-way ANOVA, Dunnett's post hoc test, Pearson's correlation coefficient	Biodynamic strawberries had significantly higher concentration of Ca, P, Fe, Cu, some phenolic acids and kaempferol compared with conventional strawberries. Agriculture method did not affect antioxidant activity.
Kahu K, Janes Hm Luik A, Klaas L, 2009	Estonia	Field trial	Black currant (cvs. 'Pamyati Vavilova', 'Zagadka', 'Ojebyn') grown conventionally and organically	Ascorbic acid	Two-way ANOVA	Organically berries had higher content of ascorbic acid than conventionally cultivated berries.
Magnani S, Baruzzi G, Bonoli M, D'Antuono LF, Elementi S, Maltoni ML, 2009	Italy	Field trial	3 years, strawberry (cvs. 'Alba', 'Onda', 'Queen Elisa') grown organically and integrated	Colour, firmness, soluble solids, titratable acidity, antioxidant capacity, total polyphenols, total ellagic acid, ascorbic acid	Two-way ANOVA, LSD test	Organic management showed significantly higher content of soluble solids, antioxidant activity and phenolic compounds and ellagic acid for two of the tree years.

Study	Location of study	Study type	Study design			Key results
			Forklaringsvariabler: *Cultivating system (organic/ecological/ biodynamic and conventional /integrated), type vekst, antall sorter/kultivarer, antall år, etc.*	*Målevariabler: Relevant parameters measured (innhold av næringsstoffer, tungmetaller, omfang av sykdomsangrep, antall skadegjørere, etc,)*	*Statistical analysis (navn på metode)*	
Tonutare T, Moor U, Molder K, Poldma P, 2009	Estonia	Field trial	Strawberry (cv. 'Polka') grown organically and conventionally	Dry matter, ascorbic acid, soluble solids, titratable acidity, anthocyanins, total antioxidant capacity	Two-way ANOVA	Strawberries cultivated under organic farming conditions had significantly higher soluble solid content, ascorbic acid and total antioxidant capacity in two-year old plants. Berries of three-year old plants had significantly higher sugar/acid-ratio and total antioxidant capacity compared to conventionally grown strawberries.
Hargreaves JC, Adl MS, Warman PR, Rupasinghe HPV, 2008	Canada	Field trial	2 years, strawberry (cv. 'Sable') grown in organic and conventional systems with 4 different compost and 1 inorganic fertilization in the conventional system	Minerals (Ca, Mg, K, Na, S, Fe, Cu, Mn, Zn, P, Cd, Cr, Ni, Pb, B), soluble solids, antioxidant capacity	SPSS, Tukey's post hoc multiple comparisons	No significant influence by the production system was found for soluble solids, antioxidant capacity, and for most of the minerals, except for higher concentration of S and Mn in inorganic fertilized berries for one year
Kazimierczak R, Hallmann E, Rusaczonek A, Rembialkowska E, 2008	Poland	Field trial	Black currant (cvs. 'Öjebyn', 'Ben Lomond', Titania') grown organically and conventionally	Dry matter, flavonols, polyphenols, antioxidant activity	Tukey's test	Significantly higher antioxidant activity flavonol concentration, anthocyanins, and a higher amount of ascorbic ac id in organic berries were found.
Anttonen MJ, Karjalainen RO, 2006	Finland	Field trial	Black currant cv. 'Öjebyn' grown conventionally and organically	Soluble solids, titratable acidity, total and individual phenolic compounds, anthocyanins	SPSS, ANOVA, Tukey's HSD, Dunnett's T3 test, PCA	No significant differences were found for black currants cultivated organically or conventionally.

Study	Location of study	Study type	Study design			Key results
			Forklaringsvariabler: *Cultivating system (organic/ecological/ biodynamic and conventional /integrated), type vekst, antall sorter/kultivarer, antall år, etc.*	*Målevariabler:* *Relevant parameters measured (innhold av næringsstoffer, tungmetaller, omfang av sykdomsangrep, antall skadegjørere, etc,)*	*Statistical analysis* *(navn på metode)*	
Häkkinen SH, Törrönen AR, 2000	Finland	Field trial	Strawberry grown in organic (cvs. 'Polka', 'Honeoye', 'Jonsok') and conventional ('Senga Sengana', 'Jonsok', 'Korona', 'Polka', 'Honeoye', 'Bounty') cultivation systems	Phenolic compounds, flavonols (quercetin, myricetin and kaempferol) and phenolic acids (ellagic, p-coumaric, caffeic and ferulic acids)	ANOVA	'Jonsok' was the only cultivar showing significant difference between the cultivation systems, with higher amounts of total phenolics, kaempferol and ellagic acid in organic grown berries. Compared to conventional cultivation techniques, organic cultivation had no consistent effect on the levels of phenolic compounds in strawberries.
Cayuela JA, Vidueira JM, Albi MA, Gutierrez F, 1997	Spain	Field trial	Strawberry produced organically and conventionally	Colour, firmness, sugar content, titratable acidity, dry matter, ascorbic acid, Ca, Mg, Fe, Mn, Cu	Variance analysis, Student's t-test	Organic fruits had significantly stronger colour, higher soluble solid and dry matter content than the conventionally grown berries. No significant effect of production system was found for firmness, titratable acidity, ascorbic acid or minerals

7.3 VEGETABLES

Table 11. Results from included studies on quality and nutritional aspects in vegetables (*Brassica* sp. (cabbage, broccoli, brussel sprouts, cauliflower, kale), carrot, tomato, lettuce, onion).

Study	Location of study	Study type	Study design			Key results
			Forklaringsvariabler: *Cultivating system (organic/ecological/ biodynamic and conventional /integrated), type vekst, antall sorter/kultivarer, antall år, etc.*	*Målevariabler:* *Relevant parameters measured (innhold av næringsstoffer, tungmetaller, omfang av sykdomsangrep, antall skadegjørere, etc,)*	*Statistical analysis* *(navn på metode)*	
Das R, Thapa U, Mandal AR, Lyngdoh YA, Debnath S, 2013	India	Field trial	2 years, broccoli, effect of organic and conventional fertilization	Ascorbic acid, carotene, total chlorophyll, total sugar content	Duncan's multiple range test	Different fertilization affected quality in broccoli, where higher ascorbic acid, carotene, total chlorophyll and total sugar content was observed in broccoli fertilized with a mixture of organic and mineral fertilizers, and lower values of the same quality variables when fertilized with inorganic fertilization only.
Kapusta-Duch J, Leszczynska T, 2013	Poland	Field trial + basket study	3 years, *Brassica oleracea* vegetables (white cabbage cv. 'Stone head', red cabbage cv. 'Langedijker' and brussel sprouts cv. 'Dolores F1') grown under diversified ecological conditions (organic farms, field around a steelwork, in addition to randomly purchased, the latter of unknown method of cultivation)	Vitamin C, β-carotene	ANOVA, Duncan's test	All species were characterized by significantly higher vitamin C and β-carotene contents (brussels sprouts) when grown on organic farms compared to vegetables grown around a steelworks or available in retail with unknown method of cultivation.
Zapata PJ, Tucker GA,	Spain	Field trial	Broccoli (cv. 'Parthenon') grown organically and	Organic acids (e.g. ascorbic acid), total	ANOVA, Duncan's multiple test	All organic acids, including ascorbic acid, were found at higher concentrations in organic

Study	Location of study	Study type	Study design			Key results
			Forklaringsvariabler: *Cultivating system (organic/ecological/ biodynamic and conventional /integrated), type vekst, antall sorter/kultivarer, antall år, etc.*	*Målevariabler: Relevant parameters measured (innhold av næringsstoffer, tungmetaller, omfang av sykdomsangrep, antall skadegjørere, etc,)*	*Statistical analysis* *(navn på metode)*	
Valero D, Serrano M 2013			conventionally	phenolic content, antioxidant activity		than conventional broccoli. No significant effect of cultivation was found for phenolic content or antioxidant activity.
Bavec M, Turinek M, Mlakar SG, Mikola N, Bavec F, 2012	Slovenia	Field trial	White cabbage (cv. 'Kranjsko okroglo') produced in different farming systems (conventional, integrated, organic and bio-dynamic)	Mineral composition (N, P, K, Ca, Na, Mg, Fe, Cu, Zn, Mn), nitrate, ascorbic acid, ash, dry matter	ANOVA	Farming system significantly influenced the content of Fe, Zn, P, K, Mn, and ash in fresh and dry samples, ascorbic acid and Mg only in fresh and Na only in dry samples. The results could not be related to one specific farming system.
Bender I, Ingver A, 2012	Estonia	Field trial	Carrot (cv. 'Jõgeva Nantes') and swede (cv. 'Kohalik Sinine') grown organically, conventionally (3 treatments for carrot and 2 for swedes) in addition to control (no pesticides or fertilizers)	Vitamin C, total sugars, dry matter	One-way ANOVA	No significant differences were found between organic and conventional production methods on vitamin C content. In swedes, vitamin C in the control was significantly higher than the rest of the growing treatments. Carrots and swedes grown organically contained significantly higher content of dry matter than conventional grown.
Botrel N, Resende FV, Leite BSF, Nassur RCMR, Boas EVBV, 2012	Italy	Field trial	Tomato (cv. 'San Vito') produced organically and conventionally	Colour, firmness, titratable acidity, total soluble solids, vitamin C, lycopene, β-carotene, total phenolics, total antioxidant activity	Tukey's test	Lycopene, β-carotene, vitamin C, acidity, phenolics and antioxidant activity were influenced by cropping system. Organically produced fruits had higher concentrations of vitamin C, soluble solids and antioxidant activity, but lower concentration of lycopene than conventionally produced tomatoes.

Study	Location of study	Study type	Study design			Key results
			Forklaringsvariabler: *Cultivating system (organic/ecological/ biodynamic and conventional /integrated), type vekst, antall sorter/kultivarer, antall år, etc.*	*Målevariabler: Relevant parameters measured (innhold av næringsstoffer, tungmetaller, omfang av sykdomsangrep, antall skadegjørere, etc,)*	*Statistical analysis* *(navn på metode)*	
Hallmann E 2012	Poland	Field trial	2 years, tomato (standard cvs. 'Merkury', 'Akord', 'Rumba' and cherry cvs. 'Picolino', 'Conchita') grown in organic and conventional production systems	Dry matter, vitamin C, polyphenols (including flavonoids), carotenoids (lycopene and β-carotene), total and reducing sugars, organic acids, 3-quercetin rutinoside, myricetin, kaempferol	Two-way ANOVA, Tukey's test	For one year (2008), organic tomatoes presented a higher ratio of reducing sugars/organic acids (due to significant lower content of organic acids and higher concentration of total sugars), significantly higher content of vitamin C and total flavonoids, 3-quercetin rutinoside, and myricetin in comparison with the conventional fruits. In 2009, organic tomatoes contained significantly higher content of vitamin C, quercetin-3-O-glucoside and chlorogenic acid, myricetin and kaempferol in comparison with the conventional fruits.
Heimler D, Vignolini P, Arfaioli P, Isolani L, Romani A, 2012	Germany	Field trial	Lettuce (*Lactuca sativa* L. ssp. *acephala* L., cv. 'Batavia red Mohican') cultivated under conventional, organic and biodynamic farming	Total phenolic content, anthocyanins, antiradical activity	ANOVA, Tukey's test	Polyphenolic content in conventional lettuce was significantly lower than in lettuce from organic and biodynamic farming. Flavonoid, hydroxycinnamic acid and anthocyanin patterns were not affected by the type of cultivation.
Jørgensen H, Bach Knudsen KE, Lauridsen C, 2012	Denmark	Field trial	2 years, carrot (cv. 'Bolero') and kale (cv. 'Bona') grown in an organic and conventional cultivation system	Carbohydrate and lipid compositions	ANOVA, GLM (SAS)	No significant effects of the cultivation systems were found.
Kapusta-Duch J,	Poland	Field trial +	3 years, *Brassica oleracea*	Total polyphenol	ANOVA, Duncan's	No significant effects of cultivation systems on

Study	Location of study	Study type	Study design			Key results
			Forklaringsvariabler: *Cultivating system (organic/ecological/ biodynamic and conventional /integrated), type vekst, antall sorter/kultivarer, antall år, etc.*	*Målevariabler:* *Relevant parameters measured (innhold av næringsstoffer, tungmetaller, omfang av sykdomsangrep, antall skadegjørere, etc,)*	*Statistical analysis* *(navn på metode)*	
Leszczynska T, Filipiak-Florkiewicz A, 2012		basket study	vegetables (white cabbage cv. 'Stone head', red cabbage cv. 'Langedijker' and brussel sprouts cv. 'Dolores F1') grown under diversified ecological conditions (organic farms, field around a steelwork, in addition to randomly purchased, the latter of unknown method of cultivation)	content, antioxidant activity	test	antioxidant activity or total phenolic content, except for white cabbage, where a lower antioxidant activity was found in cabbage grown organically.
Lucarini M, D'Evoli L, Tufi S, Gabrielli P, Paoletti S, di Ferdinando S et al., 2012	Italy	Field trial	Lettuce (cvs 'Lattuga Romana', 'Foglia di Quercia'), influence of different cultivation systems (organic and conventional) in field and spring water	Nitrate	ANOVA, Tukey's test	Both lettuce varieties biodynamically grown accumulated 1.3-2 times less nitrate than the respective organically grown plants. The two lettuce varieties showed differences in nitrate accumulating capacity: 'Foglia di Quercia' was almost three times richer in nitrate than 'Lattuga Romana'.
Picchi V, Migliori C, Lo Scalzo R, Campanelli G, Ferrari V, Di Cesare LF, 2012	Italy	Field trial	Cauliflower (cvs. 'Emeraude' and 'Magnifico'), conventional and organic management	Phytochemicals, ascorbic acid, polyphenols, glucosinolates	One-way ANOVA, Tukey's test	Farming methods had no significant effect on soluble solids, titratable acidity, ascorbic acid, total polyphenols or total carotenoids. The two cultivars showed a contrasting response to organic practices. Phytochemical content in the two cultivars were different, with a general reduction in 'Emeraude', and unaffected or

Study	Location of study	Study type	Study design			Key results
			Forklaringsvariabler: *Cultivating system (organic/ecological/ biodynamic and conventional /integrated), type vekst, antall sorter/kultivarer, antall år, etc.*	*Målevariabler:* *Relevant parameters measured (innhold av næringsstoffer, tungmetaller, omfang av sykdomsangrep, antall skadegjørere, etc,)*	*Statistical analysis* *(navn på metode)*	
						even increase in 'Magnifico'.
Rajashekar CB, Oh M, Carey EE, 2012	USA	Field trial	Lettuce, organic and conventional management practices	Phenolic compounds (L-chicoric acid, quercetin -3-O-glucoside, antioxidant capacity	ANOVA, Duncan's multiple range test	No significant difference in total phenolic content or antioxidant capacity was observed. Chicoric acid was significantly higher in organic grown lettuce. Similar increase was observed for quercetin-3-O-glucoside.
Wrzodak A, Szwejda-Grzybowska J, Elkner K, Babik I 2012	Poland	Field trial	3 years, carrot (cvs. 'Perfekcja' and 'Regulska'), conventional and organic systems	Dry matter, total sugars, β-carotene, nitrates	ANOVA, Newman-Keul's test	Carrots grown conventionally contained significantly higher content of β-carotene than carrots grown organically. Nitrate content was significantly higher in carrots grown conventionally than organically.
Martinez-Tome M, Mariscal M, Martinez-Tome J, Martinez-Tome MJ, 2011	Spain	Field trial	Broccoli (cv. 'Marathon F1' grown organically and conventionally	Carbohydrates, antioxidant activity (TEAC)	ANOVA, Fisher's test	No significant differences between organically or conventionally grown broccoli was observed.
Ordonez-Santos L, Vazquez-Oderiz M, Romero-Rodriguez M, 2011	Spain	Field trial	Tomato (cv. 'Llado' and 'Antillas') grow organically and conventionally	Micronutrients (K, Ca, Na, Mg, Fe, Zn, Mn, Cu), lycopene, β-carotene, ascorbic, malic and citric acids, total phenolic	Two-way ANOVA, Student's t-test	Cultivation method affected ascorbic acid and Mn content significantly, with higher concentrations in organic fruits. For all other nutrients examined, differences between cultivars were of greater importance than cultivation method.

Study	Location of study	Study type	Study design			Key results
			Forklaringsvariabler: *Cultivating system (organic/ecological/ biodynamic and conventional /integrated), type vekst, antall sorter/kultivarer, antall år, etc.*	*Målevariabler: Relevant parameters measured (innhold av næringsstoffer, tungmetaller, omfang av sykdomsangrep, antall skadegjørere, etc,)*	*Statistical analysis (navn på metode)*	
				compounds		
Søltoft M, Bysted A, Madsen KH, Mark AB, Bügel SG, Nielsen J, Knuthsen P, 2011	Denmark	Field trial	2 year, carrot (cv. 'Bolero'), effect of organic and conventional agricultural systems	Carotenoids	One-way ANOVA	The content of carotenoids in carrot roots was not significantly affected by the agricultural production system or year, despite of differences in fertilization strategy and levels.
Gravel V, Blok W, Hallmann E, Carmona-Torres C, Wang HY, Van de Peppel A et al., 2010	Netherlands	Field trial (greenhouse production)	3 years, tomato production in greenhouse (4hybrid cvs; 15, 40, 45, 93 (De Ruiter seeds)), organic fertilizer and three conventional tomato-cropping systems were compared	Lycopene, β-carotene, vitamin C	SAS Mixed Models procedure, Tukey's test	No significant effect of cropping system was observed.
Rodriguez J, Rios D, Rodriguez E, Diaz C, 2010	Tenerife, Spain	Field trial	Tomato (cv. 'Tyrlain') cultivated conventionally, ecological and hydroponically (in tuff and cocoa fiber)	Brix, ash, pH, acidity, ascorbic acid, total phenols	One-way ANOVA, Duncan's multiple range test	Organic tomatoes showed significantly higher moisture content and lower soluble solids, ascorbic acid and total phenolic compounds than conventional and hydroponic cultivations. Firmness correlated positively with acidity in all cultivation methods.
Søltoft M, Eriksen MR, Träger AWB,	Denmark	Field trial	2 years, carrot (cv. 'Bolero'), organically and conventionally grown	Polyacetylenes	Fitted model, pair-wise comparisons, family-wise error	The concentrations were not significantly influenced by the growth system, but a significant year-year variation was observed

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Nielsen J, Laursen KH, Husted S, Halekoh U, Knuthsen P, 2010a					rate	for falcarindiol-3-acetate.
Søltoft M, Nielsen J, Laursen KH, Husted S, Halekoh U, Knuthsen P, 2010b	Denmark	Field trial	2 years, onion (cv. 'Hytech'), carrot (cv. 'Bolero'), conventional and organic agricultural systems	Polyphenols (flavonoids, phenolic acid)	Fitted model, pair-wise comparisons, family-wise error rate	No significant differences between growth systems were found for polyphenols.
Bender I, Ess M, Matt D, Moor U, Tonutare T, Luik A, 2009	Estonia	Field trial	Carrot (cv. 'Jõgeva Nantes') grown organically and commercially	Nitrate, dry matter, total sugars, soluble solids, phosphorus, potassium, calcium and magnesium, β-carotene, vitamin C, nitrogen	ANOVA	Conventional carrots had significantly higher nitrate concentration than organic carrots. Contents of dry matter, total sugars, soluble solids, P, K, Ca and Mg did not significantly differ between carrots between the different cultivation systems. The contents of β-carotene, vitamin C and N were significantly lower in organically than in conventionally grown carrots.
Bimova P, Pokluda R, 2009	Czech Republic	Field trial	2 years, head cabbage (cv. 'Trvalo F2'), comparing of commercial brands of	Total antioxidant capacity	ANOVA, Tukey's test	The first trial year, total antioxidant capacity was significantly higher in one of the organic fertilizer treatments. The following year, no

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			alternative, organic fertilizers were compared with conventional, mineral fertilizers			significant differences of the fertilization treatments were observed.
Ordonez-Santos LE, Arbones-Macineira E, Fernandez-Perejon J, Lombardero-Fernandez M, Vazquez-Oderiz L, Romero-Rodriguez A, 2009	Spain	Field trial	Tomato cvs. 'Llado' and 'Antillas' grown organically and conventionally	Firmness, soluble solids, total acidity, pH, total solids content, colour, lycopene	Two-way ANOVA, Student's t-test	Organically grown tomatoes had a higher total solids content, total acidity and higher values of the CIELab colour parameters b*, C* and h*, but smaller values of the CIELab parameter ratio a*/b*.
Nobili F, Finotti E, Foddai MS, Azzini E, Garaguso I, Raguzzini A et al., 2008	Italy	Field trial	Tomato (cv. 'Perfectpeel') from organic and conventional cultivation	Vitamin C, lycopene, β-carotene, chlorogenic acid, caffeic acid, coumaric acid, naringenin, rutin, quercetin, total antioxidant capacity,	Student's t-test	No significant cultivation effect was observed for lycopene, naringenin and rutin content, but β-carotene and coumaric acid levels were significantly higher in the organic samples, in addition to one of the methods used for analyzing antioxidant capacity (FRAP method). Vitamin C, chlorogenic acid, caffeic acid, quercetin and the other method used to analyzing antioxidant capacity (TEAC) were significantly higher in conventional produced tomatoes.

Study	Location of study	Study type	Study design			Key results
			Forklaringsvariabler: *Cultivating system (organic/ecological/ biodynamic and conventional /integrated), type vekst, antall sorter/kultivarer, antall år, etc.*	*Målevariabler:* *Relevant parameters measured (innhold av næringsstoffer, tungmetaller, omfang av sykdomsangrep, antall skadegjørere, etc,)*	*Statistical analysis* *(navn på metode)*	
Rossi F, Godani F, Bertuzzi T, Trevisan M, Ferrari F, Gatti S 2008	Italy	Field trial	Tomato (cv. 'PS1296'), organic and conventional and integrated farming techniques	Crude protein, ash, ascorbic acid, β-carotene, lycopene, salicylic acid	One-way ANOVA, Student-Newman-Keuls multiple comparison test	Organic tomatoes contained significantly more salicylic acid but less vitamin C and lycopene than integrated and conventional.
Scalzo RI, Iannoccari T, Genna A, Cesare LFd, Viscardi D, Ferrari V et al. 2008	Italy	Field trial	6 years, cauliflower (16 genotypes), organic and conventional fields	Dry matter, soluble solids, pH, titratable acidity, vitamin C, antioxidant activity	ANOVA, Tukey's test	The differences in dry matter, soluble solids and pH between organic and conventional growing were negligible. The acidity and vitamin C was higher in organic than in conventional cauliflower.
Mitchell AE, Hong YJ, Koh E, Barrett DM, Bryant DE, Denison RF et al., 2007	USA	Field trial	10 years, tomato (cv. 'Halley 3155') from conventional and organic production systems	Flavonoids (quercetin and kaempferol)	PROC Mixed, regression	Significantly higher levels of quercetin and kaempferol aglycones were found in organic than conventional produced tomatoes.
Chassy AW, Bui L, Renaud ENC, Van Horn M, Mitchell AE 2006	USA	Field trial	3 years, tomato (CVS. 'Ropreco', 'Burbank') grown under certified organic and conventional practices	Total phenolics, soluble solids, ascorbic acid, quercetin, kaempferol, luteolin	Two-way ANOVA, GLM	Cropping system had significant effect on soluble solids, quercetin, kaempferol and ascorbic acid on a fresh weight basis. Year-to-year variability was significant, and high values from 2003 influenced the 3-year average value of quercetin reported for organic 'Burbank' tomatoes. 'Burbank' tomatoes had generally higher levels of quercetin,

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						kaempferol, total phenolics, and ascorbic acid as compared to 'Ropreco' tomatoes.
Young JE, Zhao X, Carey EE, Welti R, Yang SS, Wang W 2005	USA	Field trial	Lettuce (cv. 'Kalura', 'Red Sails'), grown in organic and conventional systems	Phenolic acids, flavonoids	One-way ANOVA, Tukey's post-hoc test	No effects by growing system on phenolic compounds were found.
Caris-Veyrat C, Amiot MJ, Tyssandier V, Grasselly D, Buret M, Mikolajczak M et al. 2004	France	Field trial	Tomatoes (cvs. 'Félicia', 'Izabella', 'Paola') grown organically and conventionally in field and tunnel	Vitamin C, carotenoids, polyphenol content, chlorogenic acid, lycopene, naringenin	Two-way ANOVA	When results were expressed as fresh weight, organic tomatoes had significantly higher content of vitamin C, carotenoids, and polyphenols (except for chlorogenic acid) than conventional tomatoes. When results were expressed as dry matter, no significant difference was found for lycopene and naringenin.
Colla G, Mitchell JP, Poudel DD, Temple SR 2002	USA	Field trial	2 years, tomato grown in conventional, low input and organic systems	P, Ca, N, Na	One-way ANOVA, Duncan's multiple range test	Organic fruits contained highest amounts of P and Ca. Conventionally-grown tomatoes were richer in N and Na, while the low input system had an intermediate values for N, P, and Na, and the lowest Ca concentration of the three systems.
Fjelkner Modig S, Bengtsson H, Stegmark R,	Sweden	Field trial	6 years, carrot (cvs. 'Karotan', 'Duke') cabbage (cv. 'Bartolo F1'), onion	Dry matter, vitamin C (ascorbic acid), 25 different	Chi-square test	Organically grown crops had higher dry matter content than the integrated grown. However, when examining the data for the different

Study	Location of study	Study type	Study design			Key results
			Forklaringsvariabler: *Cultivating system (organic/ecological/ biodynamic and conventional /integrated), type vekst, antall sorter/kultivarer, antall år, etc.*	*Målevariabler:* *Relevant parameters measured (innhold av næringsstoffer, tungmetaller, omfang av sykdomsangrep, antall skadegjørere, etc,)*	*Statistical analysis* *(navn på metode)*	
Nystrøm S, 2000			(cvs. 'Hysam', 'Sherpa', 'Rijnsburger', 'Sturon') grown in organic and integrated farming system.	minerals and trace elements		crops, contradictory results were noted. No significant differences due to growing system were noticed for vitamin C and the other nutrients, except for 4 trace elements (molybdenum, nickel, silicon and rubidium).
Gundersen V, Bechmann IE, Behrens A, Sturup S 2000	Denmark	Field trial	Onion (cv. 'Hysam'), cultivated organically and conventionally	Major and trace elements	PCA, Student's t-test	Significantly different levels of Ca, Mg, Si, B and Se were observed between organically and conventionally grown onions. Principal component analysis (PCA) applied to the major and trace elements in onion samples split the samples into two groups depending on cultivation method.

7.4 Cereals

Table 12. Results from included studies on nutrient content in cereals. Only significant differences are given in key results.

Study	**Location of study**	**Study type***	**Study design**		**Key results** *Når et eksperiment viser motstridende resultater for ulike år så må dette komme frem her. Kun signifikante forskjeller/resultater skal nevnes her.*
			Forklaringsvariabler: Cultivating system (organic/ecological/ biodynamic and conventional /integrated), type vekst, antall sorter/kultivarer, antall år, etc.	*Målevariabler: Relevant parameters measured (innhold av næringsstoffer, tungmetaller, omfang av sykdomsangrep, antall skadegjørere, etc,)*	
Arncken et al. 2012 JSFA	Switzer-land	Field trial (DOK long-term farming system comparison)	Bio-dynamic, Bio-organic, conventional (with farmyard manure) 7 year rotation system 4 replicates Wheat (winter) – cultivar Runal 3 years (2006-2007, 2009) Statistical analyses ANOVA and Tukey test	TKW, Test weigh, protein %	BIODYN and BIOORG produced grains of 10 and 7% lower grain weights, 3 and 2,5% lower test weights and 26 and 26,4% lower protein contents, respectively compared to conventional system
Ceseviciene et al. 2012 JSFA	Lithuania	Field trials, organic and conventional fields at Institute of Agriculture, Dotnuva.	Organic and conventional Winter Wheat 4 varieties of winter wheat (Ada, Alma, Sirvinta, Zentos) 2 years (2008, 2009) 4 replicates Statistical analyses: ANOVA and calculation of LSD	Protein % Starch %	Organic system produced grain of 23,5% lower protein content, but with 2,5% higher starch

Study	**Location of study**	**Study type***	**Study design**		**Key results** *Når et eksperiment viser motstridende resultater for ulike år så må dette komme frem her. Kun signifikante forskjeller/resultater skal nevnes her.*
			Forklaringsvariabler: *Cultivating system (organic/ecological/ biodynamic and conventional /integrated), type vekst, antall sorter/kultivarer, antall år, etc.*	*Målevariabler: Relevant parameters measured (innhold av næringsstoffer, tungmetaller, omfang av sykdomsangrep, antall skadegjørere, etc,)*	
Ciolek et al. 2012 Journal of Elementology	Poland	Field trial, organic and conventional systems, Department of Herbology and Crop Cultivation Technology, Experimenta l farm Czeslawice.	Field trial including organic and conventional system Winter wheat (Legenda), barley (Rastik(naked), Skarb) and oats (Borowiak) Analysed from season 2009 <u>Statisicals:</u> ANOVA, LSD	K, Ca, Mg, Cu, Mn, Fe, Zn Fatty acid composition	**Wheat:** Significant higher content of Fe (27,59 vs 22.91 $mgKg^{-1}$), Zn (29,05 vs 21,57 $mgKg^{-1}$), Ca (0,295 vs 0.245 gKg^{-1}) and Mg (0,692 vs 0,630 gKg^{-1}), and lower content of K (3,984 vs 5,666 gKg^{-1})in the organic system. **Naked barley:** Higher content of Ca (0,330 vs 0,306 gKg^{-1}) but lower content of Mg (0,827 vs 0,871 gKg^{-1}), Cu (3,208 vs 3,576 $mgKg^{-1}$) and Fe (30,40 vs 38,12 $mgKg^{-1}$) in the organic system. **Covered oats and barley:** Lower content of Mg in organic system. Fatty acid composition is not tested statistically.
Vrcek et al. 2012 Int. J. og Food Sci. and Tech.	Croatia	Basket study	Conventional and organic whole wheat flour samples from different local supermarkets in Zagreb during May – September 2008 <u>Statisticals:</u> Analyses in triplicate ANOVA and *t-tests*	Metal elements (Mg, Al, K, Ca, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, As, Se, Sr, Mo, Cd, Pb)	Organically produced wheat was significantly higher in Mg and Mo. Conventionally produced wheat was significantly higher in Fe. (data given in figures, values not shown).
Nelson et al. 2011 Sustainability	Alberta, Canada	Field trials	Field trials on organically and conventionally managed soils – 500 m apart	Minerals (Se, Cu, Mn, Fe, Mg, K)	Conventional system higher in Se (0,131 vs 0,022 $\mu g\ g^{-1}$) and Cu (4,22 vs 3,07 ppm) Organic system higher in Zn (49,6 vs. 42,3 ppm), Fe

Study	Location of study	Study type*	Study design		Key results *Når et eksperiment viser motstridende resultater for ulike år så må dette komme frem her. Kun signifikante forskjeller/resultater skal nevnes her.*
			Forklaringsvariabler: *Cultivating system (organic/ecological/ biodynamic and conventional /integrated), type vekst, antall sorter/kultivarer, antall år, etc.*	*Målevariabler: Relevant parameters measured (innhold av næringsstoffer, tungmetaller, omfang av sykdomsangrep, antall skadegjørere, etc,)*	
			Each experiment: block design, 4 replicates 3 years (2005-2007) Wheat (Hard Red Spring) 5 varieties (Elsa, Glenlea, Marquis, Park, Superb) <u>Statisticals:</u> ANOVA, split-plot with system on main plots and cultivars on sub-plots, year random, system and cultivars fixed variables Pearsson correlations Non-metric multidimentional scaling (NMS (PC-ORD, MjM Software Design)		(58,3 vs. 46,9 ppm), Mg (1353 vs. 1270 ppm) and K (3218 vs. 3009 ppm) Response affected by cultivar
Nelson et al. 2011 Canadian Journal of Plant Science	Canada, Alberta	Field trial	Organic and conventional fields, 500m apart 3-4 year rotations 5 variaties CWRS Three seasons 2005-2007 Split plot design ANOVA, t-tests	Protein content, parameters of bread-making quality	Higher protein content in organic system Organic 16,6% Conventional 15,3%
Zuchowski et al.	Poland	Field trials	Field trials on organically and	Phenolic acid composition and	Organic system higher in total phenolic compounds, and

Study	Location of study	Study type*	Study design		Key results *Når et eksperiment viser motstridende resultater for ulike år så må dette komme frem her. Kun signifikante forskjeller/resultater skal nevnes her.*
			Forklaringsvariabler: Cultivating system (organic/ecological/ biodynamic and conventional /integrated), type vekst, antall sorter/kultivarer, antall år, etc.	*Målevariabler: Relevant parameters measured (innhold av næringsstoffer, tungmetaller, omfang av sykdomsangrep, antall skadegjørere, etc,)*	
2011 JSFA			concentionally managed soil within the same field Spring (Bombona, Parabola, Tybalt, Vinjett) and winter wheat (Bogatka, Kobra, Legenda) cultivars Complete randomized block design One year of analyses (2008) Statisticals: Two-way ANOVA and Tukey's test	protein content	in ferulic and p-coumaric acid than conventional system Lower grain weight, and lower protein content in organic system
Mateos et al. 2010	Spain	Field trials	Field trials with organic and conventional system One year analyses (2009)	Yield, protein content, NDF, ADF, in vitro dry matter digestibility	Differences in protein content: Organic 8,56% Conventional 12,10%
Neacsu et al. (2010) Romanian Agricultural Research	Romania	Field Trials	Field trials on two locations (Fundulea, Simnic) each having three systems (organic, conventional-recommanded dose fertiliser, conventional additional N) Several wheat varieties 2 years (2008 and 2009) Statisticals:	Protein content Rheological parameters (not relevant)	Significant differences between systems for protein content. Average protein contents: Organic 11.38%, Conventional, fertilized 14.17%, conventional, recommended 12.50%.

Study	Location of study	Study type*	Study design		Key results *Når et eksperiment viser motstridende resultater for ulike år så må dette komme frem her. Kun signifikante forskjeller/resultater skal nevnes her.*
			Forklaringsvariabler: Cultivating system (organic/ecological/ biodynamic and conventional /integrated), type vekst, antall sorter/kultivarer, antall år, etc.	*Målevariabler: Relevant parameters measured (innhold av næringsstoffer, tungmetaller, omfang av sykdomsangrep, antall skadegjørere, etc,)*	
			ANOVA		
Hildermann et al. 2009 JSFA	Switzerlan d	Field trials	Doc Experiment: Analyses in 2006 and 2007 Unfertilised (NOFERT), organic (BIODYN1, BIODYN2) and conventional (CON) system Split plot design ANOVA, LSD	Protein content	Average 2006-2007, in gkg^{-1}: NOFERT 107, 8 BIODYN1 94,1 BIODYN2 90,2 CON 116,9
Roose et al. 2009 Journal of Agriculture and Food Chemistry	Germany/S witzer-land	Long-term field experiments + Farm survey (paired samples, 3 pair)	DOC experiment: Organic (BIODYN and BIOORG) and conventional (CONFYM and CONMIN) and unfertilized. Soft wheat varieties (Titlies and Runal) Analysed in 2005 and 2006 MASCOT experiment: Conventional and organic. Soft (variety Bolero) and hard (variety Claudio) wheat Analysed in 2005 and 2006. Three farm paired samples of	Xanthophylls (lutein and zeaxanthin)	No significant differences between production system could be found.

Study	Location of study	Study type*	Study design		Key results *Når et eksperiment viser motstridende resultater for ulike år så må dette komme frem her. Kun signifikante forskjeller/resultater skal nevnes her.*
			Forklaringsvariabler: *Cultivating system (organic/ecological/ biodynamic and conventional /integrated), type vekst, antall sorter/kultivarer, antall år, etc.*	*Målevariabler: Relevant parameters measured (innhold av næringsstoffer, tungmetaller, omfang av sykdomsangrep, antall skadegjørere, etc,)*	
			soft wheat (derived from organic and conventional farms of short distance) from three different districts in Germany Statisticals: ANOVA and following the Tamhane test for comparisons of multiple means. Pairwise tests from the MASCOT experiment.		
Stracke et al. 2009 Journal of Agricultural and Food Chemistry	Germany/Switzerland	Field trial (DOK long-term farming system comparison	DOC experiment: Organic (BIODYN and BIOORG) and conventional (CONFYM and CONMIN) and unfertilized. 2003. 2005-2006 ANOVA and Tukey test	Carotenoids (lutein and zeaxanthin) Phenolic acids (free, soluble-conjgated, bound)	No significant difference between production system Climate variations have a greater influence on these phytochemicals in whole wheat than the production method
Turmel et al. (2009) Canadian J. of Plant Science (Short comm.)	Canada (Mani-toba/Qee-beck)	Field trials	Conventional and organic systems in both annual rotation and in rotation with perennials Analysed in all years in which wheat was grown in	N, P, K, S, Ca, Mg, Fe, Mn, Zn and Cu	In annual rotation: System affected nitrogen content (conventional vs organic – 2.5 and 2.1% N, respectively) and sulphur (conventional vs organic – 0.16 vs. 0.13 % S). No differences in N and S between organic perennial system and the two conventional systems.

Study	Location of study	Study type*	Study design		Key results *Når et eksperiment viser motstridende resultater for ulike år så må dette komme frem her. Kun signifikante forskjeller/resultater skal nevnes her.*
			Forklaringsvariabler: *Cultivating system (organic/ecological/ biodynamic and conventional /integrated), type vekst, antall sorter/kultivarer, antall år, etc.*	*Målevariabler: Relevant parameters measured (innhold av næringsstoffer, tungmetaller, omfang av sykdomsangrep, antall skadegjørere, etc,)*	
			both rotations (1996, 2000, 2004, 2005 and 2006). Statisticals: ANOVA using mixed procedure with rotation and system as fixed effects and year as a random effect		
Ingver et al. 2008 Latvian Journal of Agronomy	Estonia	Field trials	Field trials in organic and conventional systems at Jògeva Plant Breeding Institute 13 varieties of each cereal (oats, barley and spring wheat). 2005-2007 Randomized complete block design , 4 replicates Statisticals: ANOVA and LSD	Grain size, test weight, protein content, hull content in oats	Higher protein contents in conventional system – this was most pronounced in wheat Conventional vs. organic: Wheat: 151 vs. 127 gkg^{-1} Oats: 129 vs. 120 gKg^{-1} Barley: 120 vs. 116 gKg^{-1}
Annett et al. 2007 JFS	Alberta, Canada	Farm survey	Fields of the spring wheat, variety Park, on conventionally and organically	Protein content, Bread sensoric parameters (not relevant)	Protein conv 14,9% Protein organic 16,2%

Study	Location of study	Study type*	Study design		Key results *Når et eksperiment viser motstridende resultater for ulike år så må dette komme frem her. Kun signifikante forskjeller/resultater skal nevnes her.*
			Forklaringsvariabler: *Cultivating system (organic/ecological/ biodynamic and conventional /integrated), type vekst, antall sorter/kultivarer, antall år, etc.*	*Målevariabler: Relevant parameters measured (innhold av næringsstoffer, tungmetaller, omfang av sykdomsangrep, antall skadegjørere, etc,)*	
			managed land, situated less than 1 km apart 1 year - 2005 Statisticals: ANOVA – system as fixed variable, replicates as random		
Mader et al. (2007) JSFA	Switzer-land	Long-term Field trial (DOK experiment)	Two organic and two conventional systems (BIODYN, BIOORG, CONFYM and CONMIN) Wheat crops from the years 1978–1998 were subjected to chemical analysis Statisticals: ANOVA , Tukey–Kramer multiple comparison test Correlation analyses, PCA.	Macro- and microelements Amino acid composition Feeding studies (rats) Protein and starch content	No significant difference between systems in grain size and Test weight. The conventional systems achived in average 6% higher protein content. For the P, K, Ca, Zn, Mb and Co, no statistically significant differences between systems were found. A few significant system-based differences occurred for Mg, Mn and Cu, but no consistent differences between systems could be documented. No significant system-based differences in amino acid patterns.
Mason et al. (2007) Renewable Agriculture and Food Systems	Canada	Field trials	Samples from field trials grown on conventional and organic fields – 1km apart in 2003 and 2004 27 varieties of CWRS,	Physical grain characteristics and protein content, as well as sensoric /baking quality parameters (not relevant)	Conventional system gave higher grain size but no differences in protein content between systems

Study	**Location of study**	**Study type***	**Study design**		**Key results** *Når et eksperiment viser motstridende resultater for ulike år så må dette komme frem her. Kun signifikante forskjeller/resultater skal nevnes her.*
			Forklaringsvariabler: Cultivating system (organic/ecological/ biodynamic and conventional /integrated), type vekst, antall sorter/kultivarer, antall år, etc.	*Målevariabler: Relevant parameters measured (innhold av næringsstoffer, tungmetaller, omfang av sykdomsangrep, antall skadegjørere, etc,)*	
			randomised complete block design, 4 reps – 5 was selected and used for analyses (red Fife, Marquis, Thatcher, Park, McKenzie). Statisticals: ANOVA as split plot (years random vaiable) using P<0,10. Pearson's correlations.		
Wisniowska-Kielian and Klima (2007) Journal of Research and Applications in Agricultural Engineering	Poland, Mało-polska Province	Farm survey	Neighbouring organic (50) and conventional (50) farms from 25 communes. One sample from one farm (2004) Winterwheat Statistics: Correlation,	Fe, Mn, Zn, Cu	Contents in organic and conventional farms were:. 32.90-66.50 and 38.05-94.50 mg Fe, 25.03-48.10 and 22.45-44.53 mg Mn, 21.68-37.75 and 32.28-57.00 mg Zn and 2.42-5.40 and 2.64-5.01 mg Cu per kg, respectively. The mean contents were slightly higher in the conventional farms.
Krejcirova et al. (2006) Zemdirbyste/ Agriculture	Czek republic	Field trials	Variety trials on conv. and organic fields, at two different experimental stations, in the same region. Two years (2004-2005) Winter wheat varieties of	Protein content Quantifications of protein fractions by SDS-PAGE Reological measurements (not relevant)	Lower protein in organic system Changed protein composition, higher HMW-GS in conventional system, higher albumin/globulin in organic system.

Study	Location of study	Study type*	Study design		Key results *Når et eksperiment viser motstridende resultater for ulike år så må dette komme frem her. Kun signifikante forskjeller/resultater skal nevnes her.*
			Forklaringsvariabler: Cultivating system (organic/ecological/ biodynamic and conventional /integrated), type vekst, antall sorter/kultivarer, antall år, etc.	*Målevariabler: Relevant parameters measured (innhold av næringsstoffer, tungmetaller, omfang av sykdomsangrep, antall skadegjørere, etc,)*	
			different quality classes – block design Statisticals: ANOVA		
Langenkamper et al. (2006) Journal of Applied Botany and Food Quality	Switzer-land	Long-term field trial (DOK field trial)	BIO-DYN, BIO-ORG, Two CON systems (min+fyn) og (min) Analyses from 2003 Wheat Statisticals: ANOVA and Tukey test	Thousand seed weight, protein content, phosphate levels, antioxidative capacity, levels of phenols, fibre, fructan, oxalate and phytic acid	For the majority of the nutritionally important substances analysed, no significant differences between bio-dynamic, bio-organic, and conventional growing systems. Protein higher in CON - increased with fertilizer. Soluble fibers higher in BIO-DYN and lowest in CON.
Lueck et al. 2006	UK	Field trials	QLIF project	Protein content	Higher protein content in conventional system compared to organic
Wisniowska-Kielian and Klima (2006) Journal of Research and Applications in Agricultural Engineering	Poland, Mało-polska Province	Farm survey	Neighbouring organic (50) and conventional (50) farms from 25 communes. One sample from one farm (2004) Winter wheat Statistics: Correlation,	P, K, Ca, Mg and Na (DW).	No statistical differences between system Small differences between organic and conventional types of farms. Better quality of wheat grain from organic farms was not confirmed.

Study	Location of study	Study type*	Study design		Key results *Når et eksperiment viser motstridende resultater for ulike år så må dette komme frem her. Kun signifikante forskjeller/resultater skal nevnes her.*
			Forklaringsvariabler: *Cultivating system (organic/ecological/ biodynamic and conventional /integrated), type vekst, antall sorter/kultivarer, antall år, etc.*	*Målevariabler: Relevant parameters measured (innhold av næringsstoffer, tungmetaller, omfang av sykdomsangrep, antall skadegjørere, etc,)*	
Hanell et al. (2004) Acta Agriculturae Scandinavia	Central Sweden (Örebro)	Long-term Field trials	1995-2002 ORG1 and CON (both with animals) 1996-2002 ORG2 (without animals) Spring wheat (Dragon, Curry, Dacke) and winter wheat (Stava) <u>Statisticals:</u> ANOVA PCA and PLS	Protein content (all years) Amino acid composition (4 years)	Lower protein content in ORG1 (11,8%) compared to CON (12,7%). Higher contents in ORG1 compared to COV of threonine and leucine for spring wheat (ORG1:1.76 and 8.11 g/100 g crude protein), CON:1.63 and 7.72 g/100g crude protein). For winter wheat, higher contents of threonin in ORG1 compared to CON (2,21 vs.2,06 g/100g protein)./
L-Baeckstrom, et al. (2004) <u>Journal of Sustainable Agriculture</u>	Sweden	Long- term Field trials	Long-term field trials on Kvinnersta research farm with organic and conventional system (1992-2001). Winter wheat (Kosack and Stava) <u>Statisticals:</u> ANOVA and PCA	Protein content Baking quality parameters (not relevant)	Higher protein content in conventional system (11.57 % vs. 10.15%)
Eurola et al. (2004)	Finland	Field trials	Comparisons of organic and conventional at 6 locations	Se	Significant lower contents of Se in organic production, where no Se in fertiliser were applied

Study	Location of study	Study type*	Study design		Key results *Når et eksperiment viser motstridende resultater for ulike år så må dette komme frem her. Kun signifikante forskjeller/resultater skal nevnes her.*
			Forklaringsvariabler: *Cultivating system (organic/ecological/ biodynamic and conventional /integrated), type vekst, antall sorter/kultivarer, antall år, etc.*	*Målevariabler: Relevant parameters measured (innhold av næringsstoffer, tungmetaller, omfang av sykdomsangrep, antall skadegjørere, etc,)*	
Agriculture and Food Science			(same fields) 1997-98, two oat varieties. Statisticals: ANOVA, split-plot design		
Saastamoinen et al. (2004) Agriculture and Food Sciencec	Finland	Field trials	Conventional and organic field trials at the same field – six locations 1997-1998. Two oat varieties Statisticals: ANOVA, split-plot design	Beta-glucan content	No significant difference between organic and conventional cultivation on beta-glucan content. Beta-glucan content dependent of variety, season and location.
Strobel et al. (2001) Bodenkultur	Germany	Field trials	Organic system (Bernburg) and conventional (Biendorf). Variaty trials in winter wheat (10 variaties), winter rye (7 variaties) and oats (7 variaties). Analyses in one year Statisticals: ANOVA and Tukey test	Protein, ash, fat, N-free extractives, starch, sugar, NSP, beta-glucan, arabinoxylan, Ca, P, phytate-P.	N-free extractives, ash, Ca and P were higher under organic cultivation: Higher protein contents in conventional system. Values given for varieties, not average of system
Eltun et al. 1996 NJAS	Norway	Field trials	Apelsvoll Cropping System Experiment: 6 systems:	Protein, TGW, Test weight, Falling Number	1 – 1.5 % units lower protein in integrated or organic system compared to conventional

Study	**Location of study**	**Study type***	**Study design**		**Key results** *Når et eksperiment viser motstridende resultater for ulike år så må dette komme frem her. Kun signifikante forskjeller/resultater skal nevnes her.*
			Forklaringsvariabler: Cultivating system (organic/ecological/ biodynamic and conventional /integrated), type vekst, antall sorter/kultivarer, antall år, etc.	*Målevariabler: Relevant parameters measured (innhold av næringsstoffer, tungmetaller, omfang av sykdomsangrep, antall skadegjørere, etc,)*	
			Convetional, integrated and organic arable and forage cropping systems 1990 - 1993		Barley: Organic vs Conventional, arable: 10,7 vs. 11,7% Organic vs. Conventional, forage: 11,8 vs. 10.5% Oats: Organic vs Conventional, arable: 14,2 vs. 12,2% Organic vs. Conventional, forage: 13,8 vs. 12.8% Spring wheat: Organic vs Conventional, arable: 12,6 vs. 11,4% Organic vs. Conventional, forage: 12,9 vs. 10.7%

7.5 Grasses

Table 13. Results from included studies on nutrient content in forages. Only significant differences are given in key results.

Study	Location of study	Study type*	Study design		Key results *Når et eksperiment viser motstridende resultater for ulike år så må dette komme frem her. Kun signifikante forskjeller/resultater skal nevnes her.*
			Forklaringsvariabler: Cultivating system (organic/ecological/ biodynamic and conventional /integrated), type vekst, antall sorter/kultivarer, antall år, etc.	*Målevariabler: Relevant parameters measured (innhold av næringsstoffer, tungmetaller, omfang av sykdomsangrep, antall skadegjørere, etc,)*	
Adler et al. (2012). Journal of Dairy Science	Norway	Farm study	28 dairy farms, Grassland management and system: Organic (ORG) and conventional, (CON) both using short-term (re-established every 4 year) and long-term grassland management. 2008 and 2009. ANOVA, Mixed model	Botanical composition estimated before first harvest. Silage: Ash, N. soluble protein, ether extract, NDF, in vitro true digestibility	The ORG farms differed from CON farms in herbage botanical composition. ORG farms had less grass and more legumes. Small differences in silage chemical composition between systems. Silages from ORG had less protein and fat, but more NFC.
Adler, S. and H. Steinshamn (2010). Grassland Science in Europe	Norway	Farm study	32 Farms, Middle Norway Organic (O) and conventional (C) system Short-term grasslands (S) Long-term grasslands (L) One year study – 2007 Statistical analyses: PCA	Botanical composition Protein, fat, NDF, non-fibrous carbohydrates, organic matter, digestibility parameters, fatty acids	O-farms had lower proportion of *Poaceae* and higher proportion of dicotyledons than C-farms in their grassland. The dicotyledon proportion was dominated by legume species on SO farms and non-legume species on LO farms. On SO-farms the dicotyledon proportion was dominated by *Fabaceae* and on LO-farms by other dicotyledon families. *Poaceae* proportion was posetively correlated with forage crude protein, indicating that both Poaceae proportion and N

Study	Location of study	Study type*	Study design		Key results *Når et eksperiment viser motstridende resultater for ulike år så må dette komme frem her. Kun signifikante forskjeller/resultater skal nevnes her.*
			Forklaringsvariabler: Cultivating system (organic/ecological/ biodynamic and conventional /integrated), type vekst, antall sorter/kultivarer, antall år, etc.	*Målevariabler: Relevant parameters measured (innhold av næringsstoffer, tungmetaller, omfang av sykdomsangrep, antall skadegjørere, etc,)*	
					concentration increased with N-fertilisation on C-farms compared to O-farms.
Gustafson et al. (2007) Agriculture, Ecosystems and Environment	Sweden	Farm study (Barn balance study)	Ôjebyn research farm with an organic and concentional dairy farming system. Similar rotation in both systems 1998-2000	Chemical composition of silage, milk and urin/maure were measured monthly: N, Ca,Cu, K, Mg, Mn, P, S, Zn. In vitro digestibility. ANOVA	Higher % of clover in organic system (32%) compared to conventional (19%). Lower content of K in organic silage.
Geherman et al. 2003 Grassland Science in Europe	Estonia	Farm study, three pairs of farms	Three pairs of farms, three regions Two years (2000-2001) Two cuttings ANOVA	Botanical composition, dry matter, N,	No differences in botanical composition. Higher concentration of protein and higher protein yield in conventional. Higher dry matter yield in conventional.
Petterson et al. (1998) Acta Agricuturae Scandinavia	Sweden	Farm study	8 farms, 30 different fields, 23 organic, 7 conventional Variation in soil types Variation in specie combinations (mixtures): clover types (red, white, alsike), timothy, meadow fescue	Botanical composition B, Ca, Cu, Fe, Mn, Mg, P, K, Na, Zn, N, dry matter, ash, Rumen digestible organic matter	Higher % of clover in organic 61% vs 37% Harvest time and field variations caused most of the variation in chemical composition

Study	Location of study	Study type*	Study design		Key results *Når et eksperiment viser motstridende resultater for ulike år så må dette komme frem her. Kun signifikante forskjeller/resultater skal nevnes her.*
			Forklaringsvariabler: Cultivating system (organic/ecological/ biodynamic and conventional /integrated), type vekst, antall sorter/kultivarer, antall år, etc.	*Målevariabler: Relevant parameters measured (innhold av næringsstoffer, tungmetaller, omfang av sykdomsangrep, antall skadegjørere, etc,)*	
			Statistical analyses: PCA and PLSR t-tests		
Steinwender, R., et al. (2000) Bodenkultur	Germany	Field trial	Organic (BE) and conventional (KE) system (milk production) on the same field 11 year experiment	Yield, botanical composition, nutrient content of forage, feed intake, milk yield, health and fertility parameters of animals	Lower grassland yield in BE (-2000kg/ha) Similar forage nutrient content
Eltun et al. 1996 NJAS	Norway	Field trials	Apelsvoll Cropping System Experiment: 6 systems: Convetional, integrated and organic arable and forage cropping systems 1990 – 1993 Two cuttings ANOVA	Botanical composition, dry matter, NIR: protein, crude fiber, NDF, ADF, in vitro digestability, water soluble carbohydrates, ash, P, Ca, Mg, K.	% clover decreased with cropping intensity, higher in organic system. Lower dry weight in organic system. No difference in protein content, but organic system had lower protein in the first cut, but higher in the second cut compared to conventional. Lower crude fiber in organic compared to conventional. Higher ash, Ca and Mg in organic compared to conventional.

7.6 Potatoes

Table 14. Results from included studies on nutrient content in potatoes

Study	Location	Study type	System	Parameters	Key results
Palmer et al. 2013	United Kingdom	Field trial, 6 years	Organic and conventional	N, P, K, S, Ca, Mg	Conventional fertilization resulted in >40 % higher N content than organic fertilization. Also, conventional fertilization resulted in small, but significant increases in tuber S, Ca and Mg.
Griffiths et al. 2012	USA, Utah	Basket survey from 4 stores of each system	Organic and conventional	Mineral content	Organic potato contained more Mg (1154 mg/kg) than conventional potato (986 mg/kg), more Cu (21 mg/kg) than conventional (17mg/kg), less Fe (18 mg/kg) than conventional (25 mg/kg) and less Na (180mg/kg) than conventional (233 mg/kg). There were no differences in Ca, K, and Zn content between organic and conventional potato.
Lombardo et al. 2012a	Italy, Siracusa	Field trial, 2 years, 3 cultivars	Organic and conventional	Dry matter, vitamin C, nitrate, total protein	In one variety organic potato had higher dry matter content than conventional potato both years (numbers not given), in one variety there was no difference and in the third variety conventional potato had higher dry matter than organic in one of two years (numbers not given). Vitamin C content was 45 % higher in organic than in integrated potato one year, while there was no difference the next year. Nitrate content was higher in conventional than in organic potato both years (numbers not given). Total protein content was lower in organic potato (numbers not given).
Lombardo et al. 2012b	Italy, Sicily, Ispica	Field trial, 1 year	Organic and conventional	Dry matter, soluble sugars, total protein, ash, vitamin C, phenol, nitrates	Dry matter was higher in organic (22.2%) than in conventional (20.3%) potato. There were no differences in ash and total protein content. Total soluble sugars was higher in conventional (2.5%) than in organic (1.9%) potato. Also glucose, fructose and sucrose content were highest in conventional potato. Starch content was higher in organic (66.9%) than in conventional (63.2%) potato. Total phenolics were higher in organic (355 mg/100g) then in conventional (292 mg/100g) potato. Vitamin C (67 mg/100g) was higher in organic than in conventional potato (54 mg/100g). Nitrate was lower in organic (35 mg/100g) then in conventional potato (54 mg/100g).

Study	Location	Study type	System	Parameters	Key results
Flis et al. 2012	Poland	Field trial, 4 locations, 14 potato cultivars	Organic and conventional at separate locations	Starch, macronutrients, micronutrients	Starch content was higher in potato from one organic (16.2%) and one conventional (15.4%) location. The second organic had 15.1% and the second conventional had 14.7% starch. Soil pH varied from 4.1 to 7.2 at the sites. This may have influenced the figures for macro- and micronutrients in the potato. P and Ca were highest in organic potato. Also Mn was higher in conventional (8.4 and 9.3 mg/kg) than organic (7.6 and 7.4 mg/kg). For other micro- and macronutrients there were similar levels in potato from the two cultivation systems.
Herencia et al. 2011	Spain, Sevilla	Field trial, 4 years, 1 site	Organic and conventional	Content of dry matter, nitrate, N, P, K,	Dry matter was higher in 2 of 4 years in organic then in conventional potato (numbers not given). In 1 of 4 years nitrate concentration was lower in organic than in conventional potato (numbers not given). In 3 of 4 years N was lower in organic potato (numbers not given). In 1 of 4 years P was higher and K was lower in organic than in conventional potato (numbers not given).
Jørgensen et al. 2012	Denmark, Foulum	Field trial, 2 years, 1 site	Organic and conventional	Dry matter, starch, sugars	The cultivation systems had minor impact on carbohydrate and lipid composition of potato from the 3 cultivation systems.
Gilsenan et al. 2010	Ireland, Navan County	Farm survey, 2 sites	Organic and conventional	Dry matter, sugar content	Dry matter in raw potato was higher in organic (21.8 %) than in conventional potato (20.1 %). There was no difference in sugar content between the cultivation systems.
Søltoft et al. 2010	Denmark, Flakkebjerg, Foulum, Jundevad	Field trial, 2 years	OrganicA with manure, organicB with cover crop, conventional	Phenolic acids	Variations between years and sites were large compared to the differences between cultivation systems. Higher levels of the phenolic acid 5-CQA (the most abundant phenolic acid in potato) was found in organic potato with cover crop then in conventional potato (numbers not given). Dry matter content was not different between the cultivation systems.
Broćić et al. 2008	Serbia	Field trial, 2 sites, 5 cultivars, 1 year	Organic and conventional	Crude protein, protein, free amino acids, nitrate	Mean content of crude protein in dry matter was higher in organic (11.0%) then in conventional potato (9.8 %). Protein content in dry matter was also higher in organic (5.5 %) than in conventional potato (5.1%). In 6 of 10 combinations cultivar/site nitrate content was higher in conventional than in

Study	Location	Study type	System	Parameters	Key results
					organic potato.
Kristensen et al. 2008	Denmark, Aarhus and Aarslev	Field trial, 2 years, 2 sites	Organic, integrated and conventional	Mineral content, bioavailability in rat feeding test	No difference in Ca, Mg, P, K, Na, Cu, Fe, Mn, Zn, Co, V. In one of two years Mo was different: conventional (147 mg/kg) organic (282 mg/kg) and integrated (331 mg/kg).
Maggio et al. 2008	Italy, Naples	Field trial, 1 year	Organic and conventional	Dry matter, total carbohydrates, amino acids	There was no difference in dry matter, total carbohydrates, starch, sucrose, glucose and reducing sugars between the cultivation systems. Fructose was higher in conventional potato (0.5 g/100g) than in organic potato (0.4 g/100g). Organic farming increased threonine (24.5 mg/100g) compared to conventional (20.4 mg/100 g), while it significantly reduced most other amino acids and total amino acids. For 9 amino acids there were no differences between the cultivation systems.
Lehesranta et al. 2007	United Kingdom, Newcastle	Field trials at 1 site, 8 years rotation	Organic and conventional	Dry matter, N, P, K analysis. Effect of cultivation systems on protein profiles of potato tubers	Dry matter was higher in organic then in conventional potato (numbers not given). Total N content was 50% higher and total P was 10 % higher in conventional potato compared to organic potato. K content was slightly, but significantly higher in organic potato (numbers not given). Proteins identified suggest that organic fertilization leads to increased stress response in potato tubers.
Hajšlová et al. 2005	Czech Republic, South Bohemia	Field trial, 4 years, 2 sites, 8 cultivars	Organic with manure and conventional with manure and mineral fertilizers	Content of vitamin C, nitrate, chlorogenic acid, trace elements, polyphenol oxidases, rate of enzymatic browning	Vitamin C was higher in organic than in conventional potato, but with the exception of one year at one farm the differences were not significant. Nitrate content was lower in organic than in conventional potato, and at one farm the difference was significant in 3 of 4 years. Chlorogenic acid was higher at the 2 organic farms (208 and 159 mg/kg) than at the 2 conventional farms (144 and 122 mg/kg). Ni and Cu were higher in organic than in conventional potato. There were no differences in Mg, Fe, Co and Zn content of potato between the

Study	Location	Study type	System	Parameters	Key results
					cultivation systems.
Wszelaki et al. 2005	USA, Ohio	Field trial, 1 year	Organic and conventional	Minerals	In potato tuber flesh K, Mg, P, S, Cu, Fe concentrations were highest in the organic potato, while Mn was highest in conventional potato.
Ronilia et al. 2003	Finland, Juva	Field trial, 3 years. Partala Research Station	Organic and conventional	Dry matter, starch, nitrate, free amino acids, vitamin C, N, P, K, Mg, Ca	Organic potato had higher dry matter than conventional potato (numbers not given). In 2 of 3 years organic potato had higher starch content than conventional potato (numbers not given). Conventional potato contained more nitrate and free amino acids than organic potato (numbers not given). The content of vitamin C was not different between cultivation systems.
Fjelkner-Modig et al. 2000	Sweden, Skåne, Bjuv	Field trial, 2 sites, 6 years	Organic and integrated	Nitrate, nitrite, dry matter, vitamin C, minerals	Dry matter was higher in organic (22.3 g/100g) than in integrated potato (21.3 g/100g). Nitrate content was lower in organic (1.9 mg/100 g) than in integrated (2.7 mg/100 g). There was no difference in nitrite and vitamin C. Of 25 minerals and trace elements there were no differences in content except for Mo, Si, Ni and Rb, where the content in organic was slightly, but significantly higher than in integrated potato.
Jorhem & Slanina 2000	Sweden, Uppsala and Kristianstad	Farm survey	Organic and conventional, 10 pairs of selected farms	Mineral content	There were no differences in Cr and Zn content of potato from the two cultivation systems.
Rembial-kowska 1999	Poland	Field trial, 3 years, 10 cultivars	Organic and conventional	Dry matter, nitrate, nitrites, vitamin C	Dry matter was higher in organic (22.4 g/100g) than in conventional (21.1 g/100g) potato. Nitrates were higher in conventional (888.7 mg/kg) than in organic (266.6 mg/kg) potato. For nitrites and vitamin C, there were no differences between the two cultivation systems in fresh potato.
Warman & Havard 1998	Canada, Nova Scotia	Field trial, 3 years, 1 cultivar	Organic and conventional	Minerals and micronutrients. Vitamin C	Vitamin C content was not affected by the cultivation systems. P, Mg and Na contents were higher in organic than in conventional potato, while Mn content was highest in conventional potato. The N content was highest in conventional potato all 3 years. There were no

Study	Location	Study type	System	Parameters	Key results
					differences in N, K, Ca, S, B, Fe, Cu and Zn levels.
Varis et al. 1996	Finland, Lammi Potato Research Station	Field trial, 4 years, 3 cultivars	Organic, integrated and conventional	Starch,	Starch content was lower in conventional than in organic potato (numbers not given). There were no differences in vitamin C, nitrate and reducing sugars.
Eltun et al. 1996	Norway, Apelsvoll	Field trial, 4 years	Organic, integrated and conventional	Dry matter	Dry matter content of organic potato (28.5%) was higher than for integrated (25.0%) and conventional (23.9%) potato.

8 Appendix 2C - Data extracted from included studies on content of environmental contaminants

8.1 ORGANIC CHEMICAL CONTAMINANTS

Table 15. Results from included studies content of organic contaminants

Study	Location of study	Study type	Systems	Parameters	Key results
Witczak et al., 2012	Poland	Farm survey ?	*Organic/conventional farming*	*DDTs, HCHs, PCBs in rye, wheat carrot and beets*	The content of · -HCH (11 .45 ng / g dry wt) was significantly higher in the conventional than the orga nic rye grain (5. 11 ng / g DW). The aldrin concentration was significantly lower in organic grown carrot than in conventional (14.35 vs 24.15 ng/g DW) Heptachol was significantly higher in organic than conventional grown carrots (49.13 vs 6.95 ng/g dw) Significantly higher levels of dioxins expressed as TEQs in conventional rye than in organic (3.05 vs 0.09 pg TEQ /g FW.
Hilber et al, 2006	Switzerland	Farm survey	*Organic/conventional Study the impact of old soil contamination*	*OCP (DDTs, dieldrin, PCA, in cucumbers, zucchini,*	*All means < LOD, No difference between organic and conventional farming*
Pussemier et al., 2006	*Belgium*				
Gonzales et al., 2005	*Argentina*	Farm survey	*Organic/conventional (one farm of each)*	*OCP in lettuce and chard (DDTs, heptachlor, choldane, aldrin, dieldrin*	No difference between conventional/organic

8.2 NON-ORGANIC CHEMICAL CONTAMINANTS

Table 16. Results from included studies content of non-organic contaminants

Study	Location of study	Study type	Systems	Parameters	Key results
Akbaba et al., 2012	*Turkey*	*Farm*	*Conventional/organic*	*Hg, Pb, Cd, Ni, As in haricot beans*	*No difference in concentrations of Ni, Hg, Pb, As or Cd Several mean valuess below LOD in the study.*
Flis et al., 2012	*Poland*	*Field trial 4 locations 14 cultivars*	*Conventional/organic Certified organic farms*	*Pb and Cd in potatoes*	*Lower Cd concentrations were found in organic compared to conventional grown potatoes (Org: 0.11-0.13; Conv: 0.04-0.06 mg/kg DW). No difference in Hg and Pb concentrations*
Gaweda et al., 2012	*Poland*	*Field trial*	*Conventional, integrated and organic carrots 3 years, 3 different farms in vicinity of each other*	*Ni, Cr, Cd, Pb in carrots*	*Lower concentrations of Pb (0.10 vs 0.12 µg/g DM) and Cd (0.029 vs 0.022 µg/g DM). No difference oin Ni and Cr*
Domagala-Swiatkiewicz, I. and Gastol, M. 2012	*Poland*	*Farm Field trial Farm survey Basket study*	*Conventional/certified organic*	*Pb and Cd in juices from celery, carrot, red Beet*	*Mg/kg FW Carrot juice: Lower concentrations of Cd (organic 0.05 conv: 0.09 mg/kg F.M)) and Ni (organic:0.16. Conv: 0.29) in organic than conventional carrots. No difference in Pb. Red beet juice Lower concentrations of Cd (organic: 0.02; conv: 0.05 mg/kg F.M)) No statistical significant difference in Pb or Ni Celery Juice: Higher concentrations of Pb (organic 0.08; conv: 0.03) mg/kg F.M)) No statistical significant difference Cd or Ni.*
Vrcek & Vrcek, 2012	Croatia	Basket study 1	Conventional and organic whole wheat flour	Pb, Cr, Cd and As in in whole wheat flour	Significant lower concentrations of Cd, Org: 18.1-31.7; Conv: 27.2 – 47.2 µg/kg FW), As (Org: 0.7.1.7; Conv: 1.2 – 2.7 µg/kg FW) and Pb (Org: 11.4-27.4; Conv:

Study	Location of study	Study type	Systems	Parameters	Key results
					14.0 – 50.1 µg/kg FW) in organic than in conventional grown wheat Significant higher concentration of Cr in organic wheat (Cr: Org: 30.7 – 40.2; Conv: 25.2 – 33).
Bressy et al., 2013	Brazil	Basket study	Tomatoes, Organic/inorganic (and maturation stages) No documentation of certification) n= 3 in each group	Cd, Hg, Cr, Ni	The concentrations of metals were significantly lower in organic grown tomatoes than in conventionally grown tomatoes. Cd: Organic: 0.061 Conv; 0.21 µg/g DW Hg: Org: 0.154; Conv: 0.13 µg/g DW Ni:: Org: < 0.049; Conv: 0.77 µg/g DW Cr: Org: 0.15; Conv: 0.40 µg/g DW
Cooper et al., 2011	UK	Field trial 4-experiments, 4 years (2004, 2005, 2007, 2008)	Conventional /organic farming of Winter wheat Significance of organic vs conventional fertility management and crop protection management on metal concentrations	Cd, Ni, Pb in winter wheat. Minerals also studied	Increased concentrations of Ni and reduced concentrations of Cd in organic wheat compared to conventional Cd: 28.1 vs 48.3 µg/kg DW; Ni: 56.o vs. 45.7 µg/kg DW) No difference between organic and conventional grown wheat in Pb.
Zacchone et al., 2010	Italy	Field trial 2 years study, 10 varieties, 1 site	Conventional /organic farmed semolina	Cd, Pb, Cr, Ni in semolina	Semolina samples from organic grown semolina had lower concentrations than samples from conventional of Cd, (18 µg/kg vs. 82 µg/kg), Cr (50 vs 182 µg/kg), Organic samples had highest concentrations of Ni 166 vs 295 µg/kg). No difference in Pb concentrations (82 vs 94 µg/kg).
Hoogenboom et al., 2008	Netherla nds	Farm Survey/ basket study	Conventional vs organic lettuce and wheat	Pb, Hg, Cd, As	No difference between organic and conventional wheat or lettuce from conventional or organic farming.

Study	Location of study	Study type	Systems	Parameters	Key results
Kristensen et al., 2008	Denmark	Field trial 2 year, 2 sites	Organic, integrated, conventional grown potatoes, cale, carrot, peas and apples	Cd in carrot, kale, peas, apples, potatoes,	Significantly higher Cd content in conventional grown potatoes than in organic (organic: 45 mg/kg dw, Integrated: 52 mg/kg dw and conventional 68 mg/kg dw No difference for carrot, cale, peas, apples.
Rossi et al., 2008	Italy	Field exp. 1 year, 1 cultivar, 3 plots on the same farm	Conventional / certified organic/integrated grown tomatoes	Pb, Cd,	Higher concentrations of Pb and Cd in organic s compared to conventional. Cd in tomatoes grown with ntegrated practice own tomatoes was notsignificant from organic, while the Pb in these tomatoes was at the same levels as in conventional grown tomatoes.
Harcz et al., 2007	Belgium	Farm survey 4 years	Conventional/organic	Pb, Cd, Hg in winter wheat	Concentrations of Cd and Hg were not significantly different between organic and conventional grown wheat. (Cd: Conv: 61.7 and Org. 66.8 µg/kg FW; Hg: Conv: 0.24 and org. 0.22 µg/kg FW). Pb significant higher in organic than conventional. The difference was due to the sampling according to the authors. (Pb: Conv: 42.1 and Organic 100 µg/kg FW).
Rossi et al., 2006	Italy	Farm survey 15 conventional and 20 organic samples	Conventional/ organic	Pb, Cd in wheat (different varieties)	Pb levels significantly higher in organic wheat than conventional (means: 29.6 vs 8.5 µg//kg DW) Cd levels lower in organic than conventional wheat (19.5 vs 27.9 g//kg DW)
Hajslova et al., 2005	Czech republic	Field trial, 4 years, 2 sites, 8 cultivars	Organic and conventional grown potatoes with manure or mineral fertilizers	Cd,, As, Hg, Pb	No significant difference in Cd or Ni concentrations
Eurola et al., 2003	Finland	Field trials, 2 years,	Orgnic Vs conventional Official variety trials Nitrogen fertilization	Cd in oats	No significant differences between organic and conventional cultivation with same cultivars at same site. .

Study	Location of study	Study type	Systems	Parameters	Key results
					Lower Cd in organic grown oats overall, but different sites and different cultivars compared to conventional
Malmauret et al., 2002	France	Farm survey	Organic / Conventional	Pb, Cd, As, Hg in wheat, barley, buckwheat, spinach, lettuces, carrots, (n= 5-11 per product)	Pb: Higher concentrations in organic carrots than conventional (median values 530 vs 15 µg/kg FW. No difference for wheat, spinach, lettuces, barley, buckwheat. Only one (organic) sample of apple > LOQ **Cd** Higher concentrations in organic spinach than in conventional spinach (median valus 85 vs 35.5 µg/kg FW). No difference in other products **As and Hg** No difference in any product
Fjelkner-Modig et al., 2000	Sweden	Field experiments 6 years, 2 sites	Organic and integrated grown	Cd, Hg, Ni, Pb in cabbage, carrot, onion, pea, potatoes	Overall no difference in Cd, Pb or Hg (statistics including all ytears and crops) Ni slightly higher in organic than in conventional grown vegetables. No statistics on single crops.
Gundersen et al., 2000	Denmark	Farm survey 1 year 11 (onion) or 10 (peas) organic farms and 10 (onion) or 9 (peas) conventional farms	Conventional /organic 10 (onion) or 9 (peas) organic farms and 11(onion) or 10 (peas) conventional farms	Metals in the edible part, incl Pb, Cr, Cd,	No difference in any product
Jordheim &	Sweden	Wheat and	Conventional/organic	Pb, Cd, Cr, in wheat,	No significant differences between farming systems in

Study	Location of study	Study type	Systems	Parameters	Key results
Slanina, 2000		rye: from field experim. Potatoes and carrots: Farm survey, 1 year	10 pairs of farms	rye, carrots and potatoes	any crop plant..
Rembialkowska, 1999	Poland	Field trial, 3 years, 10 cultivars of potatoes	Organic vs conventional	Cd, Pb	No difference between the two cultivation systems on fresh weight. When expressed on dry weight, The Cd concentration was significantly higher in conventional than in organic (0.29 vs 0.16 mg/kg DW). Still no difference in Pb.

9 Appendix 2D - Data extracted from included studies on mycotoxins in cereal grains

Table 17. Results from studies on mycotoxins in cereal grains

Some of the included studies have tested many different mycotoxins, however, only those detected, and considered most important, have been included in the table.

Study	Location	Study type	System	Parameters	Key results
Blajet-Kosicka et al 2014	Poland	Farm survey	Organic (N=52) and conventional (N=24) rye, 2009-2012	DON, ZEA, T-2, HT-2	Higher levels of DON were recorded in conventional rye grain than in organic (median 15.0 vs 2.5 µg/kg). All four toxins were detected at higher frequencies in conventional than in organic rye grain: DON in 79% and 37% , T-2 in 38% and 27%, HT-2 in 42% and 21% and ZEN in 71% and 46% of conventional and organic rye grain samples, respectively.
Jensen et al 2013	Denmark	Farm survey	4 organic and 4 conventional strawberry growers, 700 berries from each grower, 2006	OTA and many other mycotoxins	Mycotoxins were not detected in mature strawberries from any of the eight growers, neither in additional samples of low quality berries.
Kuzdralinksy et al 2013	Poland	Farm survey	Organic (N=36) and conventional (N=22) oats 2006-2008	DON, DAS, T-2, HT-2, NIV,OTA aflatoxin	Concentration of DAS was higher in samples from conventional farms. Aflatoxin level was lower in organic than conventional in one year, but when samples from all years were considered no differences were found. No other differences in mycotoxin content in grains were found between the two cultivation systems.
Pique et al 2013	Spain	Basket survey	Organic and conventional apple juice (24 samples)	patulin	A higher incidence of positive samples in organic juices (72.5%) when compared to conventional (15.4%) and mean concentration of patulin was also higher in organic (9.3 µg/liter) than in conventional 1.4 µg/liter)
Twaruzek et al 2013	Poland	Farm survey	Organic (N=34) and conventional (N=24) oats 2009-2011	DON, NIV, T-2, HT-2, DAS, ZEA	Most mycotoxins showed a tendency to be present in greater amounts in grain from conventional than organic farms, significantly for NIV, T-2 and HT-2. The opposite was observed for DON (median conventional samples <LOQ, median organic samples 23 µg/kg).

Study	Location	Study type	System	Parameters	Key results
Vidal et al 2013	Spain	Basket survey	Organic and conventional wheat bran (37 samples) and oats bran (30 samples)	DON, ZEA, OTA	No differences in levels of neither DON nor ZEA in samples from organic and conventional production. DON levels above EU legislation in some samples. Higher levels of OTA were detected in wheat bran samples from organic production than in the conventionally produced samples; no differences were detected in oats.
Lacko-Bartosova and Kobida 2011	Slovakia	Field trial	Organic and integrated wheat with 6 crops in rotation, 3 years at the same plot (1990-2009), samples from 2007 and 2008 tested for mycotoxins	DON, ZEA	The concentration of DON was lower in organic system (average 192 µg/kg) compared with integrated system (average 362 µg/kg). Fertilization enhanced the level of DON in both systems. No effects of farming systems and fertilisation were seen for ZON.
Barreira et al 2010	Portugal	Basket study	Organic (35 samples) and conventional (109 samples) apple-based products	patulin	Patulin was detected in 20% and 24% of products of organic and conventional origin, respectively (maximum values 9 and 42 µg/kg, respectively), no differences.
Bernhoft et al. 2010	Norway	Farm survey	Organic (N=301) and conventional (N=301) Oats, barley and wheat 2002, 2003, 2004	DON, NIV, T-2, HT-2, MON	HT-2 was lower in organic than in conventional oats (mean conc 80 vs 117 µg/kg) and barley (mean conc <20 vs 21 µg/kg). T-2 was lower in organic than in conventional oats (mean conc 30 vs 43 µg/kg). DON lower in organic than in conventional wheat (mean conc 86 vs 170 µg/kg) No differences in DON concentrations in organic vs conventional barley and oats MON concentrations were lower in organic than in conventional wheat in one year (mean conc 98 vs 211 µg/kg) There were no differences in NIV concentrations in grain from the two cultivation systems.
Edwards 2009a	United Kingdom	Farm survey	Organic and conventional oats 458 samples from 2005-2008	T-2, HT-2	The mean content of the sum of T-2 and HT-2 was five times lower in organic (50 µg/kg) than in conventional (264 µg/kg) oat grains. A relatively high proportion of oats samples exceeded 500 µg/kg (fluctuating between 0 and 22% of organic oat samples and between 18 and 50 % of conventional samples during the four years).

Study	Location	Study type	System	Parameters	Key results
Edwards 2009b	United Kingdom	Farm survey	Organic and conventional wheat 1624 samples from 2001-2005	DON, ZEA, T-2, HT-2	There was no difference in the concentrations of DON and ZEA between organic and conventional wheat. However, organic samples had lower concentrations of T-2 and HT-2.
Edwards 2009c	United Kingdom	Farm survey	Organic and conventional barley 446 samples from 2002-2005	DON, T-2, HT-2	There was no difference in the concentrations of DON and T-2+HT-2 between organic and conventional barley.
Meister 2009	Germany	Farm survey	Wheat (N=110 organic, N=355 integrated) and rye (N=173 organic, N=308 integrated) 2000 – 2007	DON, ZEA	Frequency and levels of DON and ZEA were significantly lower in cereals of organic cultivation compared with cereals of integrated cultivation.
Suterska et al 2009	Poland	Farm survey	Organic and conventional meadow sward silages	OTA	No differences were found in the OTA content between the silages from the two farming systems (Paper in Polish with English summary and table / figure legends)
Hoogenboom et al 2008	The Nether-lands	Farm survey	Organic (31 samples) and conventional (40 samples) wheat 2 years (2003 – 2004)	DON, ZEA	No differences in mycotoxin content were observed in samples from organic and conventional cultivation
Vanova et al 2008	Czech Republic	Field trial	Organic and conventional wheat 3 years (2004 – 2006)	DON	The levels of DON were low in wheat from both cropping systems and there was no difference in the DON content between grain from organic and conventional system.

Study	Location	Study type	System	Parameters	Key results
Gottschalk et al 2007	Germany	Farm survey	Organic (N=35) and conventional (N=35) oats 1 year (2005)	Type A trichothecenes (T-2, HT-2, T-2 triol, T-2 tetraol)	High contamination rates were found for most of the toxins in oats from both cultivation systems (eg 100% for T-2+HT-2). Contamination levels for T-2, HT-2, T-2 triol, T-2 tetraol and NEO were lower in organic than in conventional oats.
Harcz et al 2007	Belgium	Farm survey	Organic and conventional wheat 2002-2005	DON, ZEA	No differences in DON and ZEA contents between conventionally and organically produced wheat, even if the average levels and the calculated percentiles were systematically higher for the conventional grain.
Mäder et al 2007	Switzer-land	A 21 year field experi-ment (1978-1999?)	Organic and conventional (integrated from 1985) wheat, samples from 1998 and 2000	DON, NIV	Quantities of mycotoxins detected in wheat grains were low and did not differ between cultivation systems.
Perkowski et al 2007	Poland	Farm survey	Organic (12 samples) and conventional (20 samples) wheat from 2003	DON, NIV	Higher DON and NIV were found in samples from conventional cultivation without fungicide protection compared to organic cultivation and conventional with fungicides. The major contributor was DON.
Spadaro et al 2007	Italy	Basket survey	Organic (21 samples) and conventional (32 samples) apple juice	patulin	A similar incidence of positive samples was found in conventional and organic apple juices and no difference was found in mean contamination level (9.0 vs 9.9 µg/kg, respectively)
Versari et al 2007	Italy	Basket study	Organic (8 samples), integrated (4 samples) and conventional (14 samples) apple juices	patulin	No significant differences were found in patulin content in samples from the farming systems, although the median value was higher for organic than for integrated and conventional juices (6.4, 1.2, 2.1 µg/liter, respectively)

Study	Location	Study type	System	Parameters	Key results
Baert et al 2006	Belgium	Basket study	Organic (65 samples), conventional (90 samples) and handcrafted (22 samples) apple juices	Patulin	Although, the incidence of patulin in organic (12%), conventional (13%), and handcrafted (10%) apple juices was not significantly different, the mean concentration of patulin in contaminated samples was significantly higher in organic (43.1 µg/liter) than in conventional (10.2 µg/liter) and handcrafted (10.5 µg/liter) apple juice.
Bakutis et al 2006	Lithuania	Farm survey	Organic (11 samples) and conventional (13 samples) wheat and barley, 2003	DON, ZEN, T-2	Mean DON concentrations on were lower in wheat from organic than in wheat from conventional farms (115 vs 138 µg/kg). Mean DON concentrations were higher in barley from organic than from conventional farms (113 µg/kg vs 110 µg/kg). Mean ZEA concentration were lower in wheat from organic than from conventional farms (41 µg/kg vs 138 µg/kg). Mean ZEA concentrations were lower in barley from organic than from conventional farms (46 µg/kg vs 211 µg/kg). Mean T-2 concentrations were higher in wheat from conventional farms rthan in wheat from organic farms (44 vs 25 µg/kg). Mean T-2 concentrations were lower in barley from organic than from conventional farms (21µg/kg vs 29 µg/kg).
Kralova et al 2006	Czech Republik	Farm survey	49 flax and 84 pea seed samples from organic and conventional farming, 2002, 2003	Alternaria toxins	Concentrations of Alternaria toxins were higher in organic than in conventional samples of flax seed from one year. No Alternaria toxins were detected in pea samples.
Pussemier et al 2006	Belgium	Farm survey	Organic (51 samples) and conventional 42 samples) wheat 2002, 2003	DON, OTA, ZEN	DON and ZEN contaminations were higher in conventional than in organic wheat samples Organic wheat was more frequently contaminated by OTA than conventional
Lauber et al 2005	Germany	Farm survey	Organic and conventional rye 2003, 2004	Ergot alkaloids	Lower concentrations of alkaloids were detected in organically grown rye compared to conventionally. Seven samples from 2003 exceeded the maximum allowable impurity with ergot (0.05%=1000 µg alkaloids/kg), six were from conventionally grown rye.

Study	Location	Study type	System	Parameters	Key results
Piemontese et al 2005	Italy	Basket study	Organic (69 samples) and conventional (100 samples) apple foodstuffs (juices, purees and apples)	Patulin	Patulin was detected in 26% of conventional and 45% of organic products with a higher mean concentration in the organic products (4.78 vs 1.15 µg/kg). Four samples of juices (one conventional and three organic) contained patulin at concentrations above the limit of 50 µg/kg. No difference was found in patulin mean concentrations between organic and conventional fresh apples (11.3 µg/kg vs 11.1 µg/kg).
Schneweis et al 2005	Germany	Field trial	Organic and conventional wheat 1999-2001	DON, ZEA	Both mycotoxins were detected more frequently and in higher concentrations in conventional than in organically produced wheat
Champeil et al. 2004	France	Field trial (large plots)	Organic, integrated, conventional winter wheat 2000, 2001, 2002	DON, NIV, ZEA	No consistent differences were found in mycotoxin content in grain from the organic and conventional wheat. However, organic system showed higher levels of DON contamination than conventional (1070 vs 60 µg/kg) in one year (2001), and in two years the conventional was more contaminated than the organic.
Griesshaber et al 2004	Switzer-land	Field trial	Biodynamic, organic and conventional wheat 1998 and 2000 (48 samples)	DON, NIV, HT2 and others	No differences were found in mycotoxin content in grain from the organic and conventional wheat. However, there were some indications that wheat from organic farming had lower DON contaminations than that from conventional one.
Hietaniemi et al 2004	Finland	Field trials	Organic and conventional oats 1997, 1998	DON	There were no differences in DON concentrations in the oat grain from the two cultivation systems.
Ritieni et al 2003	Italy	Basket survey	Organic and conventional apple products (44 samples)	patulin	No differences in patulin concentrations were found between organic and conventional apple-based products (28 µg/kg and 25 µg/kg).

Study	Location	Study type	System	Parameters	Key results
Birzele et al 2002	Germany	Field trial	Organic and conventional winter wheat 1997, 1998	DON	Approximately 50% lower DON content in organic than in conventional (375 vs 200 µg/kg) when no fungicide was used to control head blight, fungicide in conventional system reduced DON below organic in one year
Czerwiecki et al 2002a	Poland	Farm survey	Organic and conventional rye, wheat and barley 237 samples from 1997	OTA	Higher OTA concentrations were found in cereal grain from organic farms compared to conventional cultivation. No wheat sample from conventional farms contained the mycotoxin.
Czerwiecki et al 2002b	Poland	Farm survey	Organic and conventional rye, wheat and barley 207 samples from 1998	OTA	The average OTA amount in the cereal grain from conventional farms (202 µg/kg) in 1998 was remarkably higher than in grain from organic farms (7.9 µg/kg). This was however caused by three conventional wheat samples with very high OTA concentrations. OTA concentrations varied between 0.6 - 1024 µg/kg (48 % of samples contaminated) in wheat grain from the conventional farms and between 0.8 - 1.6 µg/kg in wheat grain from the organic farms (23 % of samples contaminated). In rye and barley, higher OTA concentrations were found in samples from organic farms compared with samples from conventional farms.
Döll et al 2002	Germany	Farm survey	Organic (46 wheat, 19 rye) and conventional (150 wheat, 50 rye) 1998	DON, ZEA	Higher DON contamination levels for conventional (mean 1540 µg/kg) than organic wheat (mean 760 µg/kg). DON levels in rye, and ZEA in wheat, were generally lower; however, conventional samples had higher levels than organic.
Jørgensen and Jacobsen 2002	Denmark	Farm survey	Organic (14 wheat, 17 rye) and conventional (405 wheat, 405 rye) 1992-1999	OTA	The levels of OTA in organically grown rye were higher than in conventional grown
Malmauret et al 2002	France	Farm survey	Organic (11 wheat, 5 barley) and	DON, NIV, HT-2	Low mycotoxin contamination levels in both organic and conventional cereals, no differences. However, organic samples were contaminated at high levels in a few

Study	Location	Study type	System	Parameters	Key results
			conventional (11 wheat, 5 barley) Apple (6 organic, 6 conventional)	patulin	cases. Organic apples were more contaminated by patulin than conventional, but the difference was not significant.
Schollenberger et al 2002	Germany	Farm and basked survey	Organic (24 samples) and conventional (36 samples) wheat	DON	The median DON content was higher for wheat originating from conventional than wheat from organic production (295 vs 120 µg/kg).
Beretta et al 2000	Italy	Basket survey	Organic (24 samples) and conventional (36 samples) apple juice	Patulin	Mean patulin concentration was higher in juices produced from organic apples than in juices from conventional apples (7.7 vs 1.0 µg/kg, respectively)
Berleth et al 1998	Germany		Organic and integrated. wheat and rye 1994-1996 (329 samples)	DON	No difference in DON concentrations was observed in samples from integrated and organic cultivation.
Eltun 1996	Norway	Field trial	Organic and conventional Wheat, barley and oats. 1991, 1992, 1993	DON, NIV	No differences in mycotoxin content were found between organic and conventionally grown cereals.
Jørgensen et al 1996	Denmark	Farm survey	Organic and integrated. Wheat, rye, oats and barley (1431 samples) 1986-1992	OTA	Rye was the crop most often contaminated and contained the highest levels of OTA. Higher contents of OTA were found in rye kernels from organic farms than from conventional farms. Such differences were not observed in wheat, barley and oats. The levels of OTA correlated with weather conditions (rainfall) at harvest.
Marx et al 1995	Germany		Organic and conventional rye (100	DON, ZEA	DON concentrations in organically grown rye were found to be higher than in conventionally grown (mean levels 427 vs 160 µg/kg). Organically grown wheat

Study	Location	Study type	System	Parameters	Key results
			samples) and wheat (101 samples)		showed slightly higher DON contamination than conventional (mean levels of 486 µg/kg vs 420 µg/kg). ZEA concentrations in organically grown grain were found to be higher than in conventionally grown, mean levels 6 vs 24 µg/kg and 4 vs 51 µg/kg in rye and wheat respectively.

10 Appendix 2E – Data extracted from included studies on seed quality

Tabell 18. Results from studies on quality of seed

Study	Location	Study type	System	Parameters	Key results
Capouchova et al 2012	Czech Republic	Field trial	Organic, conventional untreated and farm saved oats seed (4 varieties) 2010 - 2011	Germination Emergence 1000 grain weight (TGW)	No significant differences were found in the biological traits between conventional, organic and farm saved seed, although there was a tendency to higher germination, emergence and 1000 grain weight (TGW) in conventional untreated oats seeds compared to organic and farm saved seeds (germination 88.3% vs 74.2%, emergence 79.1% vs 65.4% and TGW 31.9g vs 24.9g)
Panasiewicz et al 2011	Poland	Field trials	Organic and conventional wheat seed 2007-2009	Germination Vigour	No differences were found in the sowing value of wheat seed from the two farming systems. *In Polish, with English summary and table legends*
Panasiewicz et al 2010	Poland	Field trials	Organic and conventional barley seed 2007-2009	Germination Vigour	Seeds of conventional crops showed higher germination capacity and vigor expressed in seedling growth test, seedlings growth rate test, Hiltner test, vigor index. *In Polish, with English summary and table legends*
Borowczak and Rebarz 2008	Poland	Field experi-ments	Organic, integrated and conventional barley 1997-2000	Germination Seed size	Germination was higher in seeds from organic (94.6%) than integrated (92.5%) and conventional (91.5%) cultivation. Higher proportion of the largest fraction of seed (diameter above 2,75 mm) was found in seed from organic and integrated system compared to conventional system. *In Polish, with English summary and table legends*
L-Baeckström et al 2006	Sweden	Field (farm) trial	Organic and conventional wheat 1999-2001	Seed borne pathogens	Higher infection by *Drechslera tritici-repentis* was observed in organic cropping, whereas higher infection by *Stagonospora nodorum* was found in conventional system. *Fusarium* spp were unaffected by cropping systems.
Morandin and Winston 2005	Canada	Farm survey	Organic, conventional and GM oil seed rape 2002	Number of seeds per fruit, bee abundance	Higher pollination and bee abundance were measured in organic than in conventional, and herbicide-resistant, genetically modified (GM) fields. There was a strong, positive relationship between bee abundance at sampling locations and pollination. Seed set increased with greater bee abundance.

Study	Location	Study type	System	Parameters	Key results
Kristensen 2003	Denmark	Field trial	Organic and conventional barley (four varieties) 1995-1998	Germination Mean germination time Seed size	Germination percentage was higher (87.9% vs 82.4%) and mean germination time lower (16.9 days vs 17.1 days) in organic than in conventional seeds. Seed from organic system had a higher proportion of large seeds (64.6% > 2.8 mm vs 58.2% in conventional).
Lisowicz 1999	Poland	Farm survey	Extensive, organic and integrated wheat and barley seeds, 4 x 1000 seeds each species/farm 1995-1997	Proportion of small shrivelled, brown dis-coloured seeds (indicator of seed quality and disease occurrence)	Proportion of 'small shrivelled, brown discoloured seeds' was lower in wheat seeds from integrated than in wheat seeds from organic and extensive farms (11.7%, 52.8% and 61.5%, respectively). In barley, there was no difference in 'small shrivelled, brown discoloured seeds' from integrated and organic system; however the proportion was higher in seed from extensive production (18.4%, 18.8% and 31.3%, respectively).
Bahle and Leist (1997)	Germany	Farm survey	Organic, integrated and conventional 77 wheat samples 1995	Seed borne diseases (*Fusarium* spp., *Stagonospora nodorum*)	The conventional system did not result in lower mean infection rates than integrated and organic production. Infection by common bunt (*Tilletia caries*) was slightly higher in organically produced wheat than in wheat from conventional production.

11 Appendix 2F – Data extracted from included studies on seed and seed potato quality

Tabell 19. Results from studies on the quality of seed potato

Study	Location	Study type	System	Parameters	Key results
Goloszewski and Zarzynska (2008)	Poland	Farm survey	Organic and integrated potatoes 2005-2006	virus aphids	Higher infection with potato leaf roll virus was found in potatoes from organic than in potatoes from integrated plantations. Also higher number of aphids was found in organic potato plantations. Infection with virus Y was lower in organic potatoes and the level of virus M was similar in both systems.
Zellner et al 2011	Europe	Farm survey	Organic (5 batches) and conventional (12 batches) seed potatoes 2007-2009	Late blight (*Phytophthora infestans*)	The average infection rate of the seed potatoes tested was 11%. The highest occurring rate was 38%. There were no statistically significant differences found between seed potatoes from organic (13.8 %) and conventional production (9.8 %).