

*The Duchy Originals Future Farming Programme helps farmers and growers participate in producer-led experimentation and research. It encourages innovation, knowledge exchange and development based on good farming and scientific practice. The Research Update series aims to support the process by providing highlights of relevant research and access to further information on research outcomes.*

## German organic research: selected highlights from 650 projects

**BÖLN**

Bundesprogramm Ökologischer Landbau  
und andere Formen nachhaltiger  
Landwirtschaft

### Introduction

The German Federal Programme for Organic Agriculture and other forms of Sustainable Agriculture (BÖLN) was founded in 2001, with the goal of improving the conditions for and growing the organic farming and food industry in Germany. The programme is funded by the Federal Ministry of Food, Agriculture and Consumer Protection (BMELV) and coordinated by the Federal Agency for Agriculture and Food (BLE) in Bonn. It includes both research and information dissemination activities targeted at different audiences.

Between 2002 and 2011, more than 650 research projects were funded under the programme. In 2011/12, an evaluation of the programme was carried out by Organic Research Evaluations, a consortium consisting of InterVal GmbH in Berlin, the Organic Research Centre, Elm Farm, United Kingdom and the University of Sustainable Development in Eberswalde, Germany.

The following summary of the research results in eight areas was compiled as part of this evaluation. Where available, links to the German final-reports of individual projects are provided. A longer version of each of these topic reports, including English abstracts for each project, is available via Organic E-prints at: [www.orgprints.org](http://www.orgprints.org) (for the specific links, see footnote for each section heading). Further results of current projects of the BÖLN research programme are regularly published at [www.bundesprogramm-oekolandbau.de](http://www.bundesprogramm-oekolandbau.de).

### Nutrition of pigs and poultry<sup>1</sup>

A strong focus was on the use of feed 100% organic origin (EC Organic Regulation) including the **development of a feed database** to assist in ration design.<sup>2</sup>

In experiments on the use of roughage in outdoor rearing pigs it was shown that **Jerusalem artichoke can lead to significantly higher weight gains**, compared to the control, while weight gain decreased significantly in some cases using other roughages.<sup>3</sup>

The processing methods for soybean cake and feed produced from it were tested on broiler chickens, laying hens and pigs. The aim was to develop a suitable technology to **inactivate the anti-nutritive components in soy** and increase the protein digestibility and the nutritional value.<sup>4</sup>

Five different roughages (straw, hay, clover silage, maize silage and Jerusalem artichokes) were compared in organic piglet production. The **feeding of various roughages resulted in a stabilisation of the intestinal flora** in comparison to the control group. In particular, the *Clostridium perfringens* population can be significantly reduced.<sup>5</sup>

A review of the compensatory protein uptake of organic pigs has found that it cannot be concluded that an economically relevant compensation takes place, and that **under the specific feeding restrictions of organic farming recommended lysine levels for the initial fattening period are set too high**.<sup>6</sup>

In studies of different genotypes, management and feeding strategies it was found that **turkey diets with reduced metabolisable energy (ME) and amino acid levels, in combination with free-range management, result in lower animal loss and high growth and carcass performance**.<sup>7</sup>

In a review of the use of the microalga *Spirulina platensis* in a feeding trial with fattening broilers a positive dose-response effect was observed: **the higher the amount of Spirulina absorbed, the better the carcass weights**. Due to the high cost of the *Spirulina* product (despite improved fattening and carcass performance) the economics of its use in broiler production are unfavourable. Thus the application of this product is only recommended in the first phase of the rearing (1-14 days).<sup>8</sup>

The aim of another project was the development of infrared spectrometer calibration to allow more timely **determination of the constituents, especially the protein and amino acid contents (AS), of organically produced grain legumes** immediately after harvest, in order to create optimal, demand-based rations.<sup>9</sup>

In 2011 a number of projects started with results due by 2015. As part of ICOPP ([www.icopp.eu](http://www.icopp.eu)), various locally **available protein feeding stuffs** will be tested in different feeding trials with pigs.<sup>10</sup> The supply of essential amino acids within the available protein feed, especially for poultry, is often insufficient, and another new research project is **testing approaches to produce high-quality protein feed** in the form of clover silage and use this feed in feeding trials with laying hens and broilers.<sup>11</sup>

- 1 Mono-gastric nutrition <http://orgprints.org/21874>
- 2 100% organic feed for monogastric animals (05OE008)
- 3 Quality assurance for protein feed (soybean) (06OE233) <http://orgprints.org/16490/>
- 4 Roughages in the growing season (03OE407) <http://orgprints.org/16341/>
- 5 Network animal nutrition (03OE475/F) <http://orgprints.org/5902> and <http://orgprints.org/13621>

- 6 Compensatory approach to protein in pig feed (06OE060) <http://orgprints.org/16377/>
- 7 Organic turkey production (06OE234) <http://orgprints.org/18771/>
- 8 Microalgae (*Spirulina platensis*) in broiler fattening (08OE098) <http://orgprints.org/18501/>
- 9 Fluctuations of ingredients in organic feed (06OE110) <http://orgprints.org/18703/>
- 10 Feeding strategies to feed 100% organic sources (11OE021)
- 11 Clover silage in organic poultry feed (11OE022) <http://orgprints.org/21874/>

## Health of ruminants<sup>12</sup>

In 2002-2003, a survey established the status quo of organic dairy and beef production. In a number of the 74 dairy farms investigated, **deficiencies regarding animal welfare were found, because recommendations for disease prevention had been implemented poorly.** In the production of suckler cows, only a few problems were identified.<sup>13</sup>

A further study looked at what **preventive measures against the major disease groups of mastitis, lameness, metabolic disorders** were used in organic dairy farming. Data were collected on the actual animal health situation and preventive animal health concepts were developed and made available to advisory services.<sup>14, 15</sup>

A study of **the effect of homeopathic remedies for mastitis in dairy cows** showed that the use of dry-cow antibiotics can be reduced, but their use cannot be fully eliminated in problem cases.<sup>16</sup>

Another *status quo* analysis in 2003 focused on the state of knowledge on mastitis, fertility, metabolism and claw disorders in dairy cows and selected diseases in pigs and poultry. The surveys showed that the **health status of animals in the organic livestock was not significantly different from that in conventional animal production** and that there was a relatively high incidence rate, regardless of the production method.<sup>17</sup>

In 2007, building on the previous results, **a large, interdisciplinary collaborative project on the health and performance of dairy cows** was set up.<sup>18</sup>

At the same time, the CORE Organic project on **health planning for dairy cows (ANIPLAN)** was running (also in the UK<sup>19</sup>). The German subproject included the aims to develop **animal-health-and-welfare plans (AHW plans)** for organic dairy farming, the monitoring of health and welfare of dairy cattle, and the development of advisory tools, including the **initiation of regional stable schools.**<sup>20, 21</sup> A further project on **stable schools** is still ongoing.<sup>22</sup>

In 2009, a project was initiated to aid farmers in grazing management via a web-based, decision-tree tool.<sup>23</sup>

The aim of another ongoing project is to **improve udder health in dairy goats** by identifying appropriate indicators for the early detection of subclinical mastitis.<sup>24, 25</sup>

A study on the health of organic sheep found that a significant relationship exists between somatic cell count and bacteria. **Ewes in meat and dairy systems showed the highest somatic cell counts compared to sheep in landscape management.**<sup>26</sup>

## Plant protection in organic arable and horticultural production<sup>27</sup>

Focus areas included copper replacement, resistant varieties and improved cultivation methods. One important focus was the control of **downy mildew, particularly in organic onion cultivation.**<sup>28</sup>

The growing risk of the occurrence of downy mildew in **organic onion cultivation** could be further reduced through the use of **new, mildew-resistant varieties.**<sup>29</sup>

New **alternatives to the use of copper**, such as plant extracts of sage and liquorice or microbial preparations with *Aneurinibacillus migulanus* demonstrated a significant reduction of infestation **in onion and cucumber.**<sup>30, 31</sup>

In **organic potatoes, primary stem infection by late blight (*Phytophthora infestans*)** was significantly reduced by seed dressing using **small amounts of copper** (120 g/ha, less than would be needed for a foliar treatments in the field); **this led to yields increases of up to 55%.**<sup>32</sup>

**Alternative pesticides were tested against the pea moth (*Cydia nigricana*);** here, a pyrethroid formulation showed variable effects and Spruzit-Neu® was unable to reduce pest infestation at high insect densities.<sup>33, 34</sup>

The use of beneficial insects and other cultural methods was extensively studied. **Covering Brussels sprouts with fine-meshed nets from the time of transplanting until the end of October achieved a 77% reduction in the infestation with cabbage whitefly (*Aleyrodes proletella*)** during the main infestation period in September. In field trials with point releases of the **parasitic wasp *Encarsia tricolor*, parasitism was up to 50% higher than in the reference without release;** bringing the first release forward in time **resulted in a significant pest reduction by about 60%.**<sup>35</sup> Studies on the **control of carrot fly (*Chamaepsila rosae*)** showed that a major risk factor for infestation is the **distance to fields where carrot had been grown in the previous year, and thus field selection offers a major control option.**<sup>36</sup>

Another project dealt with the **natural control of the grain weevil (*Sitophilus granarius*) by a continuous release of the ectoparasitoid *Lariophagus distinguendus* in grain stores.** This method is intended to be an affordable, easy-to-use and effective alternative to existing release methods.<sup>37</sup>

Other projects included the development of sensitive techniques to detect and quantify loose **smut pathogens in wheat and barley** and used these to develop seed treatments compatible with organic farming.<sup>38, 39, 40</sup>

12 **Animal health of ruminants** <http://orgprints.org/21872>

13 Organic milk and beef production (02OE348) <http://www.orgprints.org/13434/>

14 Preventive animal health concepts for dairy farms (02OE612) <http://orgprints.org/8512/> and <http://orgprints.org/14695/>

15 Development of preventive animal health concepts (03OE458) <http://orgprints.org/5381/>

16 Animal Health Concepts: Clinical investigation of homeopathic remedies (02OE410) <http://orgprints.org/12683/>

17 Status report on the state of animal health (03OE672) <http://orgprints.org/5232/>

18 Animal health in the food chain management of organic dairy farming (03OE406) <http://orgprints.org/14695/>

19 Animal health plans for organic farms were only compulsory in the UK, not in the rest of the EU

20 Minimising the use of medicines in organic dairy herds (07OE003) <http://orgprints.org/18772/>

21 Health and performance of dairy cows (07OE012-22) <http://orgprints.org/19933/>

22 Stable schools as a management tool in dairy farming (10OE017)

23 Farm-level control of endoparasites (08OE162)

24 Bedding materials and management (08OE196, 09OE012) <http://orgprints.org/19933/>

25 Udder health monitoring in dairy goats as a preventive measure (08OE178, 09OE016)

26 Preventive measures to improve health in sheep (08OE187) <http://orgprints.org/21641/>

27 **Plant protection- arable/horticulture** <http://orgprints.org/21869>

28 Control of downy mildew in organic onions (06OE073) <http://orgprints.org/18863/>

29 Downy mildew in organic onions: variety selection and cultivation practices (06OE034) <http://orgprints.org/18450/>

30 Control of downy mildew in organic cucumbers (06OE188),

31 Control of downy mildew in organic lettuce (06OE049) <http://orgprints.org/21138/>

32 Forecast model ECO SIMPHYT against late blight in organic potatoes (06OE326) <http://orgprints.org/16649/>

33 Pea moth control in organic field peas (05OE025) <http://orgprints.org/17316/>

34 Effects of weeds on yield in organic peas (06OE126) <http://orgprints.org/16869/>

## Plant protection in organic apple production<sup>41</sup>

From the outset, the search for **alternative materials for apple scab** (*Venturia inaequalis*) **control** was prioritised, since the **use of copper as a treatment for scab was going to be restricted in the future**, and the efficiency of materials approved for treating organic apples has often been too low in the past to prevent significant yield losses.<sup>42,43</sup>

**Alternatives were tested** and compared, including materials from *Inula viscosa*, *Quillaja saponaria* bark, citrus species and *Saponaria officinalis*. These plant-derived products were able to significantly reduce ascospore potential of scab and **the combination of *Quillaja saponin* and sulphur reduced scab very strongly**. The combination of citrus extract with GREEMAX and BIOPLUSS as adhesives had a similar effect as a quantity of 400g Cu/ha (applied as copper oxychloride) in field trials.<sup>44</sup>

Targeted treatments with lime sulphur during the time of sporulation were found to represent a good and safe alternative. ***Gloeosporium* infestation was significantly reduced by additional MycoSin treatments pre-harvest**.<sup>45</sup>

Furthermore, **autumn foliage removal** with leaf blowers, and the **promotion of earthworm activity are being tested to reduce fungal inoculum**.<sup>46</sup>

In recent years, **codling moth** (*Cydia pomonella*) populations have appeared that showed low susceptibility to the commonly used codling moth granulovirus (CpGV) preparations, and thus cannot be properly controlled with this treatment. Following research new CpGV isolates were developed that are able to break this resistance. **Commercial farms with CpGV resistance or suspected resistance are recommended to use the new virus isolates**.<sup>47, 48</sup>

In on-going experiments, **other methods of codling moth control are being tested, such as the use of nematodes and *Trichogramma* wasps**. Investigation of the individuals resistant to new and other potential isolates of CpGV as well as a risk assessment regarding resistance development are prioritised in the current projects.<sup>49</sup>

## Soil fertility<sup>50</sup>

Research projects at the beginning of the programme studied specific subject areas in this focus topic, such as **comparison of various mulch materials<sup>51</sup>, nutrient mobilisation (especially phosphorus)<sup>52</sup>, humus balance<sup>53</sup> and soil erosion<sup>54</sup>**. This addressed gaps especially in methods for organic practice, where data acquired from conventional agriculture were not applicable.

35 Control of cabbage whitefly using natural enemies in organic Brussels sprouts (06OE339)

36 Avoiding carrot fly damage in organic carrots (06OE095) <http://orgprints.org/18200/>

37 *Lariophagus distinguendus* to control granary beetles in stored organic grain (05OE040)

38 Control of smut (*Ustilago* sp.) in organic barley and wheat (06OE341) <http://orgprints.org/21607/>

39 Smut detection in barley and wheat (06OE349) <http://orgprints.org/21607/>

40 Control of dwarf bunt in organic wheat (06OE081) <http://orgprints.org/20630/>

41 **Plant protection- apples** <http://orgprints.org/21875>

42 Reduction of scab inoculum to minimise copper use in organic apple production (09OE044)

43 Reduction or substitution of copper use in apple scab control (09OE043)

44 Alternative substances for apple scab control and copper replacement (02OE109) <http://orgprints.org/4743/>

45 Reduction of copper use in apple scab control (06OE324) <http://orgprints.org/19277/>

46 Autumn foliage treatments to develop effective apple scab treatments (09OE037)

The joint research project on the management of soil fertility in organic farming, for example, examined a number of factors that interact in this field, such as **tillage and soil compaction, fertilisers, green manures and cover crops, weed and disease pressure, crop species and yield levels, energy consumption and the use of machinery**, but also **cost-benefit analyses of promoting soil fertility** and recommendations for farmers.<sup>55, 56</sup>

Other projects addressing the need to increase soil fertility investigated the **influence of agronomic management measures on soil quality**,<sup>57</sup> and of **various aspects of reduced tillage**; these projects continue a systems approach.<sup>58</sup>

In 2011 a status quo analysis of **long-term field experiments** in German-speaking countries was conducted, which included **comparisons of systems** employed to study the **long-term impact of management measures on soil fertility**, and to identify further research needs.<sup>59</sup>

## Food quality and processing<sup>60</sup>

In a project on **meat curing agents (nitrite and nitrate)** consumer acceptance of cured meat products which do not use these curing agents, has been described as surprisingly positive, and the practical use of alternative materials and technologies was evaluated. It was found that the implementation of new technologies to **reduce the use of curing agents was mainly inhibited by their lacking acceptance in practice, technical adaptation needs and investment in product development as well as disputed legal issues**.<sup>61, 62</sup>

As part of another project, a **guide for meat processors** was created, within which the new curing methods and solutions were presented.<sup>63</sup>

To enhance knowledge transfer regarding the **new EU hygiene standards** for organic meat processors in 2008, a number of general information and specific documents for the admission application as well as templates for the necessary internal controls were developed.<sup>64</sup>

The general use and suitability of new **organic food additives were examined**. Different substances, like binding agents or antioxidants, were tested. **Locust bean gum, guar gum, xanthan and agar agar showed a sufficient bond-stabilising effect without affecting the sensory quality of the products**. Substances such as ascorbic acid, citric acid, rosemary extract, ginger and lemon juice showed a **satisfactory effect against oxidative browning reactions**.<sup>65</sup>

The use of **rye sprouts as an ingredient in wheat bread** produced very positive results, with improved volume, crumb firmness and crumb elasticity.<sup>66</sup> The use of **yam** (*Dioscorea batatas*) **was also investigated regarding the potential sensory and health benefits for flour blends**.<sup>67</sup>

47 Decreased sensitivity of the codling moth to granulovirus (05OE023/1-2) <http://orgprints.org/18236/> and <http://orgprints.org/18235/>

48 Development of apple scab inoculum in apple variety mixtures (06OE194) <http://orgprints.org/16698/>

49 Virulence management in the codling moth (09OE097)

50 **Soil fertility** <http://orgprints.org/21868>

51 Mulching materials (02OE565) <http://orgprints.org/17201/>

52 Phosphate mobilisation (02OE424) <http://orgprints.org/17240/>

53 Humus balance (03OE084/1, 03OE084/2) <http://orgprints.org/16447/>

54 Soil erosion (06OE256) <http://orgprints.org/18812/>

55 Management of soil fertility (08OE004-9)

56 Increase and utilisation of soil fertility (08OE020, 08OE147)

57 Influence of farm management on the structure and function of the soil microflora (11OE001)

58 Reduced tillage and green manures (11OE002)

59 Status quo analysis of long-term field experiments (10OE036) <http://orgprints.org/19317/>

In another project, **the use of yeast extract in organic foods** was reviewed. It was shown here that there is very little research about the components and nutritional effects of yeast extract; also a survey among experts could not come to a clear formulation of conclusions. **Thus, it was recommended that each processor should decide for or against the use of yeast extract on a case-by-case basis.**<sup>68</sup>

Since 2008, an **additive list has been published annually.** A website was created where manufacturers of additives can register and submit their organically certified and non-certified commercial products for evaluation.<sup>69</sup>

The data from the **National Nutrition Survey** of 2010 were analysed in detail, looking at **organic buying habits in relation to socio-demographic characteristics, parameters of health and nutrition behaviour as well as food consumption.** It was found that organic buyers compared with non-organic buyers are more likely to lead a healthier lifestyle. Altruistic buying motives, such as interest in **fair trade, animal welfare and the rejection of genetic modification,** were identified as central drivers of organic buying behaviour. It was recommended, in addition to ethical arguments, to integrate **health benefits** more directly into the marketing of organic food.<sup>70</sup>

### **Regional marketing**<sup>71</sup>

This topic was initiated through a meeting in 2004, where the **social, regional and fairness aspirations which the organic sector sets itself were evaluated.** Objectives of the meeting were to identify ways for self-help and to designate specific forms of political support in this area.<sup>72</sup>

A key focus was on regional marketing, for example in the Berlin-Brandenburg region, where **barriers to the development of regional marketing along the entire organic food chain were identified.**<sup>73</sup>

The aim of the project 'Collaborative Producer-Trade-Concept' was to explore how through regional orientation **the specialist organic trade can be better positioned in the market,** and how farmers can be more involved in the marketing process. The investigation showed that **having a range of regional products alone is not sufficient to establish a regional image** of a business. To achieve this, the **active use of instruments of regional marketing** has to be combined with for example the **region's image.**<sup>74</sup>

The **joint marketing of organically and conventionally produced local produce** was studied in another project. A risk assessment of common regional brands was carried out and a 'charter of regional organic marketing' developed.<sup>75</sup>

In the '**Farmer-Consumer Partnership**' marketing and communications strategies were examined that are suitable

for organic farmers. It was found that **customers show greater willingness to pay for organic products that have the additional attributes of regional, animal welfare and 'fair prices for farmers.'**<sup>76</sup> However, the experience of test markets in the project 'Fairness along the Supply Chain' showed that **'organic-fair' products do not sell automatically; the values have to be well communicated.**<sup>77</sup>

### **Knowledge transfer**<sup>78</sup>

Over the years numerous events, workshops and conferences have been organised, through which a large number of practitioners from all sectors and regions were reached. For example, between 2004 and 2006 a total of **355 events were held to allow regional advisers and representatives of associations to provide knowledge transfer themselves** in the form of organising events and sessions, and thus reach the target audience directly.<sup>79</sup> **Between 2006 and 2008 a total of 769 events were held to transfer knowledge,** which again reached large numbers of stakeholders.<sup>80</sup>

The results of projects on the **market and marketing issues** have shown that the **selling point 'organic' alone is no longer sufficient for consumers to buy organic products,** but that for companies that produce, process or sell organic products, **credibility has to be the highest priority.** All activities of the economy must be environment friendly, socially, morally and ethically sound, and inflict no harm. The problem here is that consumers are not, or not yet, ready to pay the higher price for their higher aims. It will be one of the great challenges of this century to **provide information and educational work in the global context to achieve the corresponding fair prices at the retail level.**<sup>81</sup>

The aim of another project was to combine the experience of practitioners, advisers and researchers and to work out **concrete and practical recommendations on reduced-tillage systems in organic agriculture.**<sup>82</sup>

Since 2003, under the **advisory-practice network,** several working groups have been set up, which developed **farm-comparison and farm-enterprise-evaluation methods** (for pork, poultry, dairy, arable and horticulture).<sup>83</sup>

More '**know-how**' events were held in 2008, where also other actors within the organic food industry have been reached, who were previously not sufficiently informed about new results from research and development.<sup>84</sup>

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60 **Food quality** <http://orgprints.org/21871>

61 Curing agents in organic meat products (04OE003/1) <http://orgprints.org/10466/>

62 Sodium nitrite in raw sausage products (04OE003/1F) <http://orgprints.org/14568/>

63 Reduced use of curing agents (06OE007) <http://orgprints.org/14275/>

64 Implementing requirements of the hygiene regulations (07OE042) <http://orgprints.org/17298/>

65 Development and identification of suitable additives (06OE248) <http://orgprints.org/16467/>

66 Sprouted grains as a novel, multifunctional ingredient in baked goods (06OE167) <http://orgprints.org/18230/>

67 Alternative additives for organic products (yam) (08OE027)

68 Use of yeast extract in organic food (08OE073) <http://orgprints.org/17187/>

69 Technical ingredients, food additives and processing aids (06OE168) <http://orgprints.org/17363/>

70 Analysis of the data of the National Nutrition Survey II (08OE056, 08OE069) <http://orgprints.org/18055/>

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71 **Regional marketing** <http://orgprints.org/21873>

72 Conference: organic market and social situation (02OE668) <http://orgprints.org/3291/>

73 Sustainable metropolitan region Berlin-Brandenburg (04OE046) <http://orgprints.org/11107/>

74 Development of regional value chains (06OE085) <http://orgprints.org/18089/>

75 Collaborative Producer-Trade-Concept (CPTC) (06OE235) <http://orgprints.org/16111/>

76 Farmer Consumer Partnership (2006-1897) (07OE004) <http://orgprints.org/11028/>

77 Fairness along the supply chain (08OE105) <http://orgprints.org/17273/>, <http://orgprints.org/19516/> and <http://orgprints.org/17109/>

78 **Knowledge transfer** <http://orgprints.org/21870>

79 Coordination of activities relating to knowledge transfer (04OE031/1-8) <http://orgprints.org/9977/>

80 From organic research to practice (06OE022/1-5) <http://orgprints.org/13094/> and (06OE211/1-7) and (08OE015) <http://orgprints.org/16830/>

81 Analysis of research results (06OE301) <http://orgprints.org/13769/>

82 Evaluation of practical experience and research (06OE107) <http://orgprints.org/17200/>

83 Advisory practice network for knowledge exchange (06OE231) <http://orgprints.org/18387/>

84 Know-how events for organic practitioners (08OE214-22) and (09OE021)