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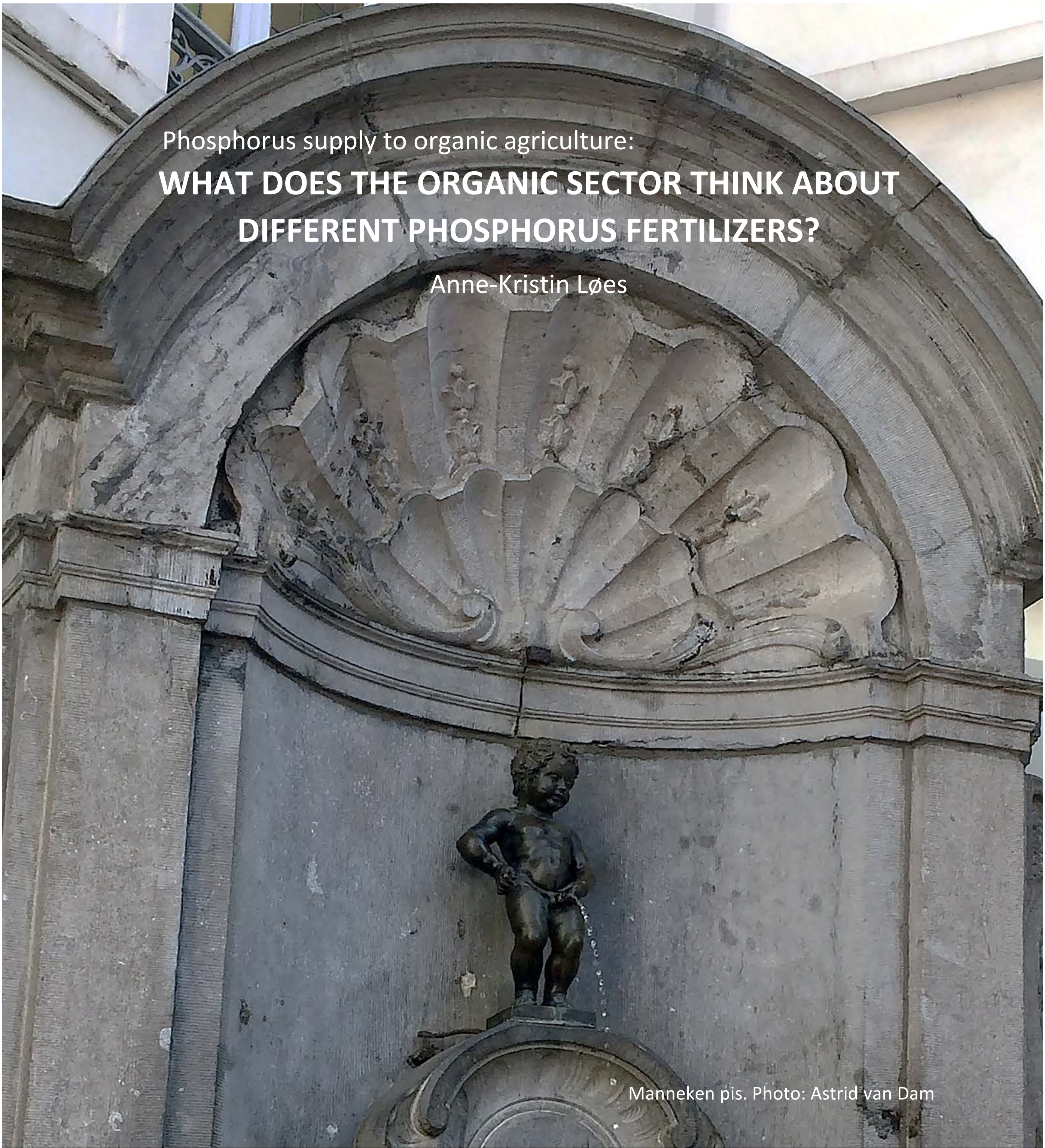
Phosphorus supply to organic agriculture:

WHAT DOES THE ORGANIC SECTOR THINK ABOUT DIFFERENT PHOSPHORUS FERTILIZERS?

Anne-Kristin Løes



Manneken pis. Photo: Astrid van Dam

Report from workshops conducted in the IMPROVE-P project to map stakeholders' opinions about recycled phosphorus fertilizers

TITTEL/TITLE

WHAT DOES THE ORGANIC SECTOR THINK ABOUT DIFFERENT PHOSPHORUS FERTILIZERS?

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SUMMARY:

Workshops were held in sixEuropean countries participating in the CORE Organic-project IMPROVE-P, to explore the opinions among organic agriculture (OA) stakeholders on recycled fertilizer products. Phosphorus (P) will be depleted over time in soil via export of farm products, and needs replacement to maintain soil fertility. Green waste was the most popular fertilizer product, accepted by more than 90% of the respondents. Least popular was conventional manure from fur animals, but even for this material, more than 30% of the stakeholders were willing to accept its use in OA. There is a large interest among organic stakeholders in fertilizer products derived from human excreta, provided these can be controlled to be safe with respect to food safety issues (pathogens, pharmaceuticals, heavy metals and other pollutants). More than 60% of the respondents accepted the use of human urine and sewage sludge in OA. The results of this study indicate that organic stakeholders are ready to accept more recycled P fertilizers into OA, as long as means are taken to ensure sufficient purity, safety and environmental efficiency of such products. This calls for adaptations in the regulations for authorization of fertilizers and soil amendments to certified organic production.

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Preface

This report is an output of the project "IMproved Phosphorus Resource efficiency in Organic agriculture Via recycling and Enhanced biological mobilization" (IMPROVE-P, 2013-2016). The project was funded by the CORE Organic II funding bodies of Austria, Denmark, Germany, Great Britain, Norway and Switzerland. The project was aimed at developing strategies to balance P cycles in organic farming with improved recycling of P on-farm and from society. Whereas the project mainly studied agronomic means to ensure P supply to organic crops, one work package, WP4 studied stakeholders' opinions towards different P fertilizers that may be purchased from outside the farm when required. Workshops were conducted in all countries and at two international events. In all workshops, project partners and invited speakers presented relevant background knowledge, and pros and cons of relevant fertilizers were discussed. Then, the participants filled in questionnaires to record opinions about P fertilizers. This report presents the output of the nine workshops.

Norwegian Centre for Organic Agriculture (NORSØK) became a partner in the IMPROVE-P project in January 2016, after Bioforsk was merged with two other research institutes to establish the Norwegian Institute of Bioeconomy Research, NIBIO. This fusion led to the re-establishment of NORSØK as an active research institute.

I am grateful to all colleagues and organizations who kindly assisted in arranging the workshops.

Anne-Kristin Løes

Tingvoll – 15.06.2016
Anne-Kristin Løes, senior researcher NORSØK, leader of WP4 in IMPROVE-P

Norwegian summary/Sammendrag på norsk

Prosjektet «Forbedret effektivitet av fosforressursene i økologisk landbruk gjennom resirkulering og biologisk mobilisering» (IMPROVE-P) var et samarbeid mellom Danmark, Norge, Storbritannia, Sveits, Tyskland og Østerrike i regi av det europeiske forskningssamarbeidet CORE Organic.

Det fjernes næringsstoffer fra matjorda gjennom salg av produkter, og med mindre reservene er store bør disse erstattes for at jordas fruktbarhet skal opprettholdes. Fosfor (P) er av stor betydning for planteveksten, og mange jordtyper har begrensede reserver. Muligheten til å erstatte solgt P med innkjøpt P er begrenset i økologisk landbruk, siden det ikke er tillatt å bruke lettløselig mineralgjødsel. Næringsstoff og organisk materiale i ulike typer avfall bør tilbakeføres til jordbruksarealer. En stor andel av det fosforet som er tilgjengelig for resirkulering befinner seg i materiale som mennesker skiller ut – urin og ekskrementer. Dette er foreløpig ikke tillatt å bruke i økologisk dyrking, men det er økende interesse for å resirkulere både næringsstoff og organisk materiale fra kloakkslam og avløpsvann. Med forbedringer i renseteknologi kan kanskje gjødsel fra mennesker være en måte å tilbakeføre P til økologisk dyrking? Konvensjonell husdyrgjødsel og kompost av kildesortert husholdningsavfall og/eller parkavfall er de vanligste kildene til resirkulert P i dag, sammen med råfosfat og kjøttbeinmel. P fra råfosfat frigjøres imidlertid svært sakte, særlig i jord med pH >6, og kjøttbeinmel er ofte ikke tilgjengelig fordi det brukes til fôr. Gjennom konvensjonell gjødsel gjør økologisk landbruk seg avhengig av konvensjonelt landbruk. Kompost og råtnerest fra ulike typer organisk materiale er aktuelle P-kilder i økologisk dyrking, men i praksis er det ofte blandet inn substrater som ikke er tillatt etter dagens økologiregelverk.

IMPROVE-P prosjektet gjennomførte en spørreundersøkelse i hvert land for å kartlegge hva aktører innen økologisk landbruk mener om hvilke typer tilleggsgjødsel som er best egnet når jorda har behov for P-tilførsel. Kompost fra parkavfall var førstevalg; mer enn 90% av deltakerne mente at dette var en akseptabel gjødsel i økologisk dyrking. På sisteplass i en lang liste med mulige gjødselprodukter kom konvensjonell husdyrgjødsel fra pelsdyr, men til og med dette gjødselslaget ble akseptert av mer enn 30% av deltakerne. Det var gjennomgående stor interesse for gjødsel framstilt av avløpsvann og kloakkslam, forutsatt at man kan garantere at produktene er trygge mht. patogener, medisinrester, tungmetaller og andre miljøgifter. Mer enn 60% av deltakerne aksepterte bruk av human urin og kloakkslam i økologisk dyrking.

Contents

Background

Need for phosphorus supply to organic farming systems

Organic farmers sell agricultural products, which implies export of nutrients. While farms are able to recover nitrogen (N) via biological fixation, other nutrients will be removed, and should be replenished by returning equivalent amounts of nutrients, e.g. via recycled fertilizers. Phosphorus (P) is a scarce resource (e.g. Cordell & White 2011), and hence of special interest in nutrient recycling. There are several studies indicating negative nutrient balances for organic arable farming systems throughout Europe (e.g. Kolbe 2016; Friedel et al. 2014; Haas et al. 2007; Gosling & Shepherd 2005; Løes & Øgaard 2001). Some pioneers of organic farming strongly advocated recycling of urban organic wastes, including human excreta (Howard 1943). However, organic agriculture (OA) also has a precautionary principle of care, aiming for the production of high quality products with a minimum level of contaminants, which may be a concern in recycled fertilizers (e.g. Küpper 2008; Lu 2012). Hence, alternatives for P substitution for net P exports are restricted by EU regulations, not only within EU member states but also in countries like Norway and Switzerland, which have implemented EU regulations on organic farming as national law as a part of the European Economic Area (EEA) agreement. It should be noted that some organic farming systems, e.g. vegetable production based on purchased organic and mineral fertilizers, may have nutrient budgets with a large surplus of P due to a low N/P ratio in the applied animal manures and composts (Kolbe 2016; Tittarelli et al. 2016; Zikeli et al. 2014, 2016), or because of high imports of feed e.g. to free range pig production. Hence, not all organic farming systems are in need of P supply from outside the farm.

Authorized fertilizers for P-supply

Fertilizers obtained from outside the farming system that are authorized in certified organic agriculture are listed in Annex I of EU regulations for organic production, EC 889/2008 and later amendments, see Table 1. Products containing significant amounts of P in this Annex include:

- Conventional animal manure, provided the production is not defined as factory farming
- Recycled P fertilizers such as anaerobically digested or composted source-separated household waste, green waste from gardens and recreational areas, vegetable food processing waste
- Specific animal residue products such as meat and bone meal, blood meal, fish meal
- Wood ash
- Rock P
- Slag from the metal industry

Currently non-authorized products that could be considered as P supply to organic farming systems include food residues from catering, retail and processing industry, incineration slags/ashes and products derived from human excreta. The Expert Group for Technical Advice on Organic Production (EGTOP) recently published a report proposing that fertilizers derived from human waste, specifically struvite and renewable calcined phosphate, should be authorized in organic production (EC 2016). Meanwhile, their utilization is hampered because they need to become authorized under the general regulations for fertilizers in the EU, EC 2003/2003.

Rock P is authorized, but dissolves poorly in neutral and alkaline soils. Compost and digestates may be made from organic waste from recreational areas and food residues. However, for food residues, only source-separated household waste is authorized. This seriously hampers the utilization of composts and digestates in practice, since this feedstock is very often treated together with other non-authorized feedstocks, prohibiting they use in organic farming.

Table 1: Annex I, Fertilizers and soil conditioners authorized for use in organic agriculture (EC 889/2008, amended by Commission Regulations M1-M15; EC 2015). Compound products or products containing only the listed materials

Name	**Description**	**Compositional requirements and conditions for use**
Farmyard manure	Product comprising a mixture of animal excrements and vegetable matter (animal bedding)	Factory farming origin forbidden
Dried farmyard manure and dehydrated poultry manure		Factory farming origin forbidden
Composted animal excrements, including poultry manure and composted farmyard manure included		Factory farming origin forbidden
Liquid animal excrements		Use after controlled fermentation and/or appropriate dilution Factory farming origin forbidden
Composted or fermented household waste	Product obtained from source separated household waste, which has been submitted to composting or to anaerobic fermentation for biogas production	Only vegetable and animal household waste Only when produced in a closed and monitored collection system, accepted by the Member State Max. in mg/kg of dry matter: Cd 0.7; Cu 70; Ni 25; Pb 45; Zn 200; Hg 0.4; Total Cr 70; Cr (VI) not detectable
Peat		Use limited to horticulture
Mushroom culture wastes		Initial composition limited to products of this Annex
Dejecta of worms (vermi-compost) and insects		
Guano		
Composted or fermented mixture of vegetable matter	Product obtained from mixtures of vegetable matter,	which have been submitted to composting or to anaerobic fermentation for biogas production
Biogas digestate containing animal by-products co-digested with materials of plant and animal origin as listed in this Annex	Animal by-products (including by-products of wild animals) of category 3 and digestive tract content of category 2 (EC 1069/2009),	must not be from factory farming origin. The processes have to be in accordance with EU 142/2011. Not to be applied to edible parts of the crop.

Products or by-products of animal origin	Listed compounds: Meals of blood, hoof, horn, bone, degelatinized bone, fish, meat. Feather, hair, ‘chiquette’ meal. Wool, fur, hair, dairy products, hydrolyzed proteins	Max. in mg/kg of dry matter of fur: Cr (VI) 0 Hydrolyzed proteins shall not be applied to edible parts of the crop.
Products and by-products of plant origin for fertilizers	Examples: Oilseed cake meal, cocoa husks, malt culms	
Seaweeds and seaweed products		As far as directly obtained by: (i) physical processes including dehydration, freezing and grinding (ii) extraction with water or aqueous acid and/or alkaline solution (iii) fermentation
Sawdust and wood chips		Wood not chemically treated after felling
Composted bark		Wood not chemically treated after felling
Wood ash		From wood not chemically treated after felling
Soft ground rock phosphate	Product as specified in EC 2003/2003	Cd ≤ 90 mg/kg P_20_5
Aluminum-calcium phosphate	Product as specified in EC 2003/2003	Cd ≤ 90 mg/kg P_20_5 Use limited to basic soils (pH > 7,5)
Basic slag	Product as specified in EC 2003/2003	
Crude potassium salt or kainite	Product as specified in EC 2003/2003	
Potassium sulphate (K_2SO_4), possibly containing Mg salt	Product obtained from crude K salt by a physical extraction process	
Stillage and stillage extract		Ammonium stillage excluded
Calcium carbonate	Chalk, marl, ground limestone, Breton ameliorant, maerl, phosphate chalk	Only of natural origin
Magnesium and calcium carbonate	E.g. Magnesian chalk, ground magnesium, limestone	Only of natural origin
Magnesium sulphate (kieserite)		Only of natural origin
Calcium chloride solution		Foliar treatment of apple trees, after identification of deficit of Ca
Calcium sulphate (gypsum)	Product as specified in EC 2003/2003	Only of natural origin
Industrial lime from sugar production	By-product of sugar production from sugar beet	

Industrial lime from vacuum salt production	By-product of vacuum salt production from brine found in mountains	
Elemental Sulphur	Product as specified in EC 2003/2003	
Trace elements	Inorganic micronutrients listed in EC 2003/2003	
Sodium chloride		Only mined salt
Stone meal and clays		
Leonardite	Raw organic sediment rich in humic acids	Only if obtained as a by-product of mining activities
Chitin	Polysaccharide obtained from shells of crustaceans	Only if obtained from sustainable fisheries as defined in EC 2371/2002 or organic aquaculture
Organic rich sediment from fresh water bodies formed under exclusion of oxygen (e.g. sapropel)	Only organic sediments that are by-products of fresh water body management or extracted from former freshwater areas Maximum concentrations in mg/kg of dry matter: cadmium: 0,7; copper: 70; nickel: 25; lead: 45; zinc: 200; mercury: 0,4; chromium (total): 70; chromium (VI): not detectable	When applicable, extraction should be done in a way to cause minimal impact on the aquatic system Only sediments derived from sources free from contaminations of pesticides, persistent organic pollutants and petrol like substances Max. in mg/kg of dry matter: Cd 0.7; Cu 70; Ni 25; Pb 45; Zn 200; Hg 0.4; Total Cr 70; Cr (VI) not detectable

Workshops and questionnaires

The current inputs available for maintenance of soil fertility in OA are limited, and sometimes controversial. Utilising conventional manure does not support the integrity of OA, and there are concerns about antibiotics and other veterinary drugs as well as pesticide residues. Composting organic waste is linked to significant losses of greenhouse gases, and biogas digestate is often a mixture of waste materials which makes digestate unavailable for OA in practice. Animal by-products are often utilised for feed and hence not available. In any case, the largest proportion of P available for recycling is found in human excreta. Should OA accept new types of recycled fertilizers to maintain long-term soil fertility? Which inputs are the best, when the soil P status calls for P enrichment? Such questions were developed in a questionnaire (Q) designed to record opinions of organic agriculture stakeholders on a range of potential P fertilizers obtained from outside the farm holding. The Q was first made in English, and later translated into German, Danish and Norwegian. The English version of the Q is shown as Attachment 1 to this report. Linked to various national conferences (Table 2), workshops were held in all partner countries during 2014-16, in addition to workshops during the Organic World Congress in Istanbul, Turkey in 2014 and the international fair Biofach in Germany in 2015. In Germany, two national workshops were arranged, giving a total of nine workshops. Country names are abbreviated as follows: Austria = AT, Denmark = DK, Germany = DE, Great Britain = GB, Norway = NO, Switzerland = CH.

The workshops were arranged to map the opinions of the stakeholders about relevant P fertilizers, so that we could study how opinions vary within and between partner countries, and between major stakeholder groups across countries. At all events, the workshops started by expert presentations showing the need for P supply to OA, and pros and cons of relevant products. A good example is shown in Attachment 10. Discussions followed the presentations, or in some cases were done during or after the filling-in of questionnaires, dependent on the time frame. Programs of all events are shown as an Attachments 2-9 to this report.

In total, 213 Qs were filled in (Table 2). Information was given about gender, age and working position. The contents of Qs were compiled in Excel sheets, and results extracted by calculating averages and proportions. The participants filled in whether they found different products being acceptable (A), not acceptable (NA) or if they preferred to not decide: undecided (UD). Where no answer was given, or respondents had written A/NA etc., the answer was changed to UD. For other questions, averages were computed with the actual number of answers. The products were structured into Conventional animal manure, Urban waste products, Products originating from human waste, and Other Alternative P fertilizers (APFs). Both authorized and non-authorized products were included. People were encouraged to give in comments to each APF, e.g. criteria for its acceptance. Participants were further asked to rank relevant APFs according to their preference for each compound in an organic farming system. People were asked about their degree of (dis)agreement with statements commenting e.g. the need for P in organic farming, and finally if the workshop had made them more positive, or more skeptical, about the use of recycled P fertilizers in organic farming.

Photos from the IMPROVE-P workshops in Wels, Austria 27 January 2016 (upper left) and Istanbul 14 October 2014. Project participant Dr. Jürgen Friedel. BOKU, Vienna (upper left) and project leader Kurt Möller, University of Hohenheim, Germany (upper right) presenting studies on recycled fertilizers to the audience, before discussing in groups and filling in questionnaires. Photos: FiBL

Table 2. Information about IMPROVE-P workshops and participating stakeholders. Age = Average age, age of youngest + oldest participant, Gender = % of Males and Females, Position = % of farmers (F), scientists (S), advisors (A) and others (O). Country codes according to http://www.worldatlas.com/aatlas/ctycodes.htm

Location	**Event**	**Date**	**No. of Qs**	**Age, years Mean Min-max**	**Gender M/F**	**Position**	**Countries represented**
Istanbul TR	Organic World Congress *English*	14 Oct 2014	17	46.4 26-68	41 / 59	F S A O 0|53|35|12	DE 3, DK 5, FI 1, FR 3, GR 1, NL 2, RO 1, SE 1
Solihull GB	National Soil Sympo-sium *English*	25 Nov 2014	58	46.9 21-67	71 / 29	F S A O 60| 9| 9|22	IE 2, BR 1, GB 56
Nurem-berg DE	Biofach *English*	13 Feb 2015	21	36.6 20-81	50 / 50	F S A O 14|19|10|57	AR 1, CR 1, DK 1, DE 8, GB 1, IL 1, NL 6, SE 1
Ebers-walde DE	13th Science conference for OA, WiTa *German*	19 Mar 2015	8	34.5 21-52	37 / 63	F S A O 0|75| 0|25	DE 8
Røros NO	Organic 3.0 Innovation and societal develop-ment *Norwegian*	13 Nov 2015	13	49.8 29-64	38 / 62	F S A O 31|23|15|31	NO 13
Frick CH	Expert workshop on recycled fertilizers in OA *German*	24 Nov 2015	34	44.5 22-61	74 / 26	F S A O 24|50|9|17	CH 33, DE 1
Vingsted DK	National Organic Congress *Danish*	25 Nov 2015	19	48.8 26-64	53 / 47	F S A O 21|11|16|52	DK 17, NO 2
Bad Boll DE	Farmer's Conference of Bioland *German*	27 Jan 2016	16	47.0 22-60	78 / 21	F S A O 81| 0| 0| 19	DE 15
Wels AT	National Farmers' Conference of BioAustria *German*	27 Jan 2016	27	35.7 15-64	88 / 12	F S A O 54| 4| 8|38	AT22, DE 1, IT 2
Total or average			213	44.0 15-81	62 / 38	F S A O 38|23|11|28	

Results and discussion

Age, gender and working positions

The youngest group was at the workshop in Austria, where many students participated (Table 2). On average, the respondents were 44 years old, ranging from 15 to 81. The gender balance varied between workshops, and between stakeholder groups. On average, close to 40% of respondents were female (Table 2). Farmers and students were dominantly men (87 and 84%), whereas 48% of scientists were women. For stakeholders in organizations/management and advisors, a majority were women (57 and 59% female). Farmers comprised the major group of stakeholders, on average 38% (Table 2). Scientists were the second largest group (23%), whereas advisors comprised 11%. The group "Other" in Table 2 (28%) comprises six respondents (3%) who had not informed about their working position, 9% students, and 15% stakeholders working in certification bodies, governmental or non-governmental organizations, business, management, as teachers, journalists, and in some cases defining their role as consumer.

Positive impact of the workshop

A majority of the participants stated that the workshop made them more positive towards the use of APFs in organic farming (Fig. 1). The same pattern was found across stakeholder groups, with some variation. Students, farmers and advisors were most positively affected, whereas a larger proportion of scientists and organization/management employees found that the workshop had no impact on their opinion. The group which became more skeptical was generally small, but highest among the farmers; 13%. On average for all respondents (n= 213), 19% did not answer the question about the impact of the workshop on their opinion. For those responding, 58% indicated that they had become more positive about the use of recycled P fertilizers in organic farming, 9% had become more skeptical, and for 33%, the workshop did not have any impact.

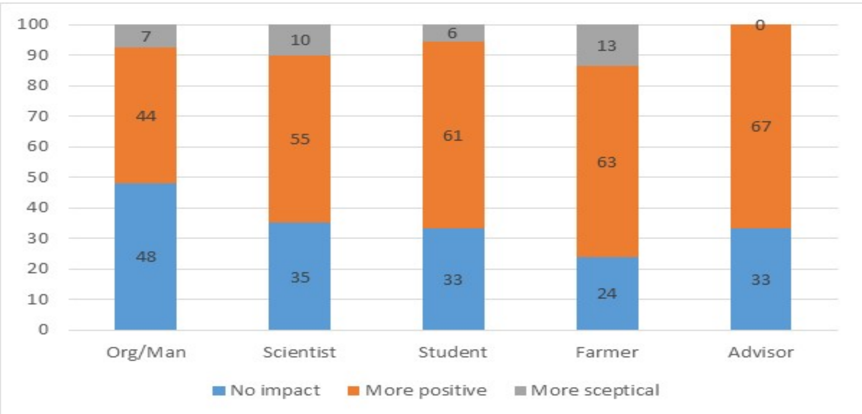
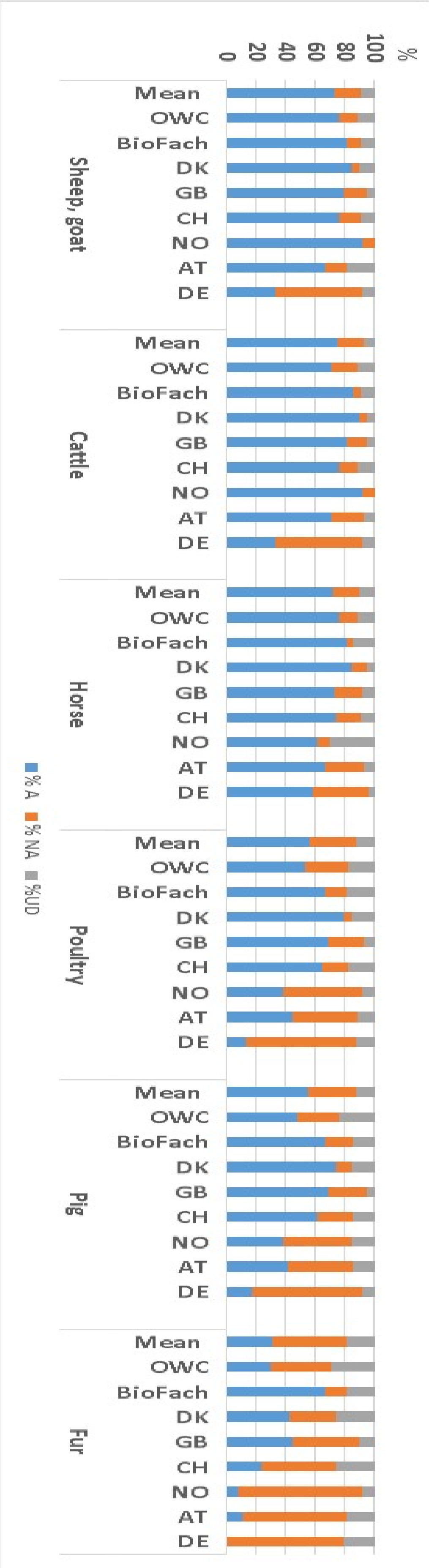


Figure 1. Impact of workshop on the opinions of different stakeholder groups across workshops (%). Org/Man is a mixture of respondents employed in certification bodies, organizations, business, management etc.

Conventional animal manure: Ruminants and horses preferred



In Figure 2, types of conventional manure are ranked in order of decreasing acceptability from top to bottom. Within each manure type, the individual workshops are shown in order starting with the overall mean value, then the two international workshops, followed by each country workshop. The order of countries is the same within each manure type, attempting to set those countries that were generally least positive towards the end.

Manure from small ruminants (sheep and goats), cattle and horses was accepted by a majority of stakeholders, except from the German respondents who were generally very critical towards all use of conventional manure in organic agriculture. Conventional manure from poultry and pigs was also accepted by more than 40% of the stakeholders, except from in Germany. Even manure from fur animals was considered acceptable by 40 % of Danish stakeholders, and by more than 60% of the respondents at the international workshop during BioFach 2015. In general, Danish stakeholders were more positive towards the use of conventional animal manure than any other group. This is remarkable, since in this country, organic stakeholders have put up ambitious goals to restrict the use of conventional animal manure in organic farming (Oelofse et al. 2013). Stakeholders from Great Britain were also generally positive, whereas Austrian stakeholders were more negative, although not as negative as the German. Stakeholders from Norway were especially positive towards manure from ruminants. Except from manure from fur animals, Swiss stakeholders were generally positive towards conventional manure.

To study whether gender affected the opinions about conventional manure, a figure was made with all respondents, dividing them into male and female (Fig. 3). No significant effect was found of gender with respect to the acceptance of conventional manure in organic farming systems. Both groups preferred manure from ruminants and horses, and were most negative towards manure from fur animals.

Personal comments showed that residues of pesticides, hormones and pharmaceuticals, e.g. antibiotics and medicines against parasites, and also GMO feed, were major reasons for concern about utilizing conventional manure in OA. Management intensity was also commonly mentioned. Some stakeholders commented that straw as bedding material was important, and a few mentioned animal welfare, e.g. that animals should have access to outdoor areas. High concentrations of copper and zinc from pig manure due to feed additives was mentioned by several respondents, since excess concentrations of these elements increases weight gain in pigs. One respondent proposed to set the same limits for application of conventional animal manure as are valid for source-separated organic waste compost. Only one respondent (DK) commented that the reason for being reluctant towards conventional manure was the dependency on conventional agriculture. A respondent from Great Britain stated that “Banning the use of manure from intensive systems will not stop the cruel practice of factory farming. It also makes the organic movement look ridiculous in the eyes of outside critics”.

Figure 2. Proportions of stakeholders regarding different types of conventional manure as acceptable (A) or not acceptable (NA) within organic farming standards, arranged with decreasing level of acceptance.

One respondent in the Biofach workshop considered all animal manure to be welcomed in OA, and stated “I don’t care about the type of animals”. Contrary to this, another respondent at stated that conventional animal manure should be recycled (provided contaminant free) if that is what is available, however should be phased out within specific time, to avoid dependency. Instead, green manure and human waste are recommended by this respondent. In line with this, a respondent in the GB workshop stated that there is a “Significant waste of P due to farming animals and eating meat/milk/eggs or using fur/skin. Plug this leak.” Another quite radical respondent argued that “Using animals is .. not acceptable to up to half of people (50%) in various ways” (GB). This shows that some organic stakeholders are dedicated to avoid animal husbandry in general, also within OA.

Figure 3. Effect of gender (Male= M, Female = F) on the degree of acceptability of conventional animal manure on organic farming standards. A = acceptable, NA = non-acceptable, UD = undecided.

Urban waste products

In Figure 4, types of urban waste are ranked in order of decreasing acceptability. Within each type of waste, the workshops are ordered starting by the mean value, then the two international workshops, and then the countries arranged by decreasing acceptability in general, but in the same order within each type of waste. The order was slightly different from the order of countries for conventional manure. Danish stakeholders were again most positive, followed by British and Swiss. Norway was put last because of the large proportion of “Undecided”, and Austrian stakeholders were somewhat less positive towards urban waste than German.

Waste from parks and gardens, as well as food waste from private households, are accepted by 80 % or more of the stakeholders as fertilizers in OA provided the material is composted or digested (Fig. 4). The one exception to this is Norway, where the stakeholders were remarkably uncertain about these nutrient sources. With respect to other types of food waste, coming from catering or industry, there are larger disagreements between stakeholder groups than was found for conventional manure. Whereas the group at Biofach unanimously found catering food waste to be a good product to recycle as fertilizer, only about 40% of Austrian stakeholders accepted this fertilizer source. Stakeholders from German-speaking countries, especially Germany and Austria, were generally more skeptical towards other food waste than from private households, whereas respondents from other countries were much more positive. On average, recycled food waste was more popular to use than conventional manure from poultry, pigs and fur animals.

In personal comments, several respondents mentioned the risk of residues of pesticides being applied in private gardens, and heavy metals (from traffic and handling). Plastic residues in food waste were of concern, and a high content of sodium (Na) in catering residues.

A few stakeholders claimed that they would accept only plant based fertilization products. One commented that food waste from households and catering should not occur.

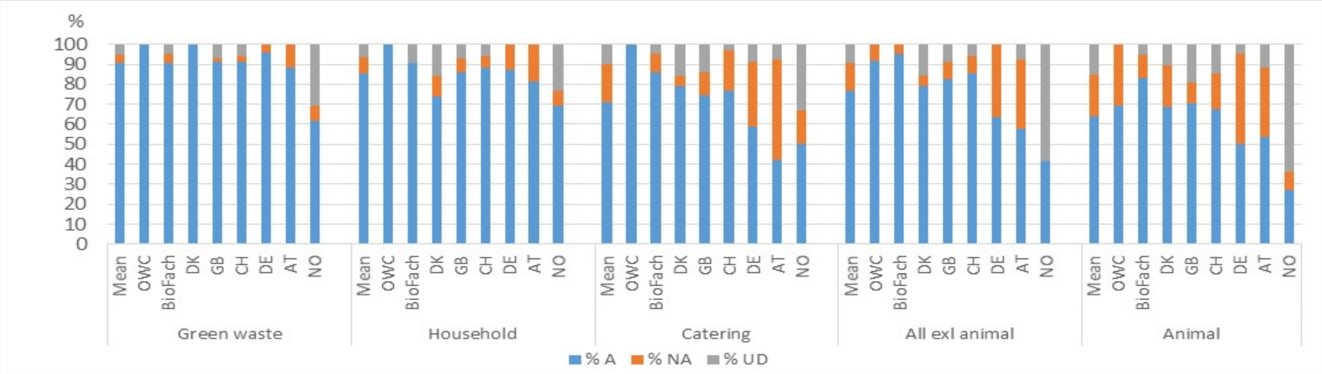


Figure 4. Proportions of stakeholders regarding different types of recycled organic waste (composted or anaerobically digested) as acceptable (A) or not acceptable (NA) within organic farming standards, or being undecided (UD), arranged in decreasing levels of acceptance or uncertainty. Green waste = from recreation areas; Household = source separated household food waste; Catering= food waste from institutions, restaurants, trade etc.; All excl. animal = food waste from food processing industry, excluding animal products; Animal = food waste from animal products e.g. abattoir.

Products originating from human waste

In Figure 5, types of fertilizers derived from human excreta are ranked in order of decreasing acceptability. Within each type of fertilizer product, the workshops are in order starting with the mean value, then the two international workshops, and then the countries arranged by decreasing acceptability in general, but in the same order within each type of product. The order was different from the order of countries for conventional manure and urban waste. Stakeholders from Great Britain were now overall the most positive, closely followed by Danish stakeholders. Swiss stakeholders were very positive about precipitation products and urine, but very skeptical about sewage sludge products. Austrian and German stakeholders followed each other closely and were less positive about urine products, but more positive about sludge products than the Swiss. Norwegian stakeholders were very negative about sludge, and more uncertain about urine products than stakeholders from Germany and Austria. A significant difference was found for products derived from liquid human waste material, and from the solid phase of sewage (Fig. 5). Ashes were considered somewhat more acceptable than stabilized sewage sludge. Stakeholders from German-speaking countries, where the utilization of human excreta as fertilizer in agriculture is more restricted than in Scandinavia and GB, were generally skeptical towards the use of sewage sludge and ashes, especially in Switzerland where sewage sludge is normally incinerated since 2006. Norwegian stakeholders were generally much more restrictive about fertilizers from human excreta than Danish. Utilization of urine and precipitation products from swage were accepted by more than half of the stakeholders, except for the Norwegians being somewhat less positive towards precipitation products.

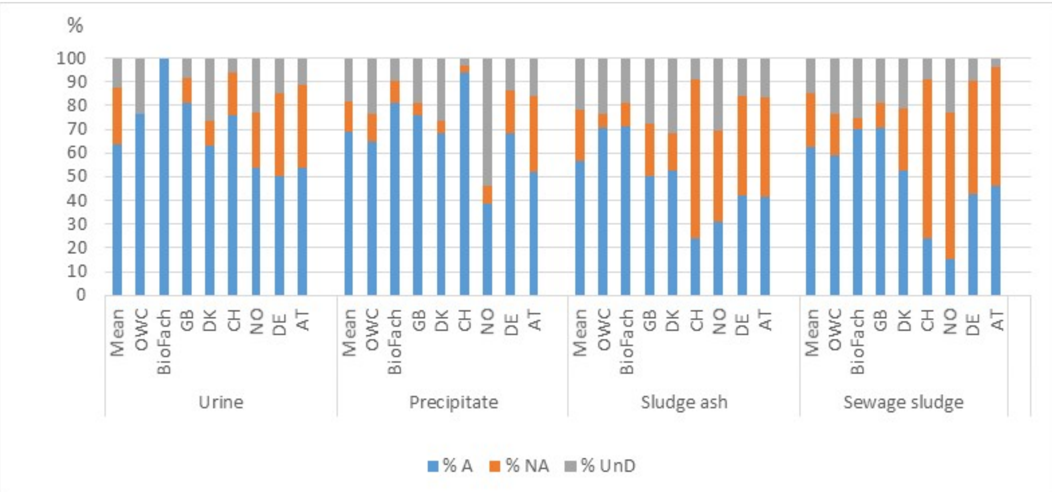


Figure 5. Acceptability of different types of fertilizer products obtained from human waste such as urine, P precipitated from sewage, sewage sludge or ashes from incinerated sewage sludge, in organic farming, assessed by stakeholders in different countries, explained in Table 2. Products regarded as acceptable (A), not acceptable (NA) within organic farming standards, or undecided (UD). Products and workshops arranged with decreasing level of acceptance.

In the personal comments, one respondent asked if precipitated salts could still be called organic. In line with this, one stakeholder commented that extraction methods for precipitation products should not be chemical, or if precipitation could be said to be a synthetic process. Another was concerned about high energy consumption for stripping ammonia off from sewage. One stakeholder from Switzerland was concerned about the carbon loss when incinerating sewage sludge. This carbon should have been utilized for soil fertility building. Asked about whether the respondent could accept the production of recycled N mineral fertilizer (ammonium carbonate, ammonium sulphate), e.g. from human excreta, most respondents were positive. Concerns were raised about energy consumption, solubility of the fertilizer and the pollution risk. This question was only asked in Austria, Germany and Switzerland.

One personal comment by a stakeholder from Argentina (Biofach) stated: “We have had bad experiences with sewage sludge importations. I think they are very important tools for recycling P and really think they should be taken into consideration, but very, very carefully to prevent more damage than benefits”. In line with this, a personal comment from GB questioned that “For urine products, antibiotics and medication are real problems with unknown affects if applied to organic soils. We don`t know enough and don`t know how "clean" these products can be made. What about source-separated human faeces? For sludge products, antibiotics and medication as well as other contaminants are still an issue”. Another British stakeholder stated that it was a prerequisite for utilization of human excreta that “..humans stop using drugs/contraceptives etc. When the drugs used and the treatment system are not agreeable, it will be wrong to condone (tolerate) such utilization”.

For materials like meat and bone meal and food residues, several respondents stated that the animals or residues should be of organic origin. This opinion was also raised for human excreta by one respondent from GB: “Human excreta should be only from organic food eaters. Sensible to recycle. But not logical for organic farmer to use if they are to receive higher prices”. Another GB respondent agreed to this: ““From a general sustainability viewpoint, using recycled P is entirely logical. But if organic farmers wish to attract premium prices, and be true to their self-sufficiency principles, it is NOT logical to use recycled P from general sources that include non-organic materials”. Another was even more skeptical: “I think there is a lot of waste organic matter that could be put to good use. Indeed, it is very important that it does. However, it may be used as another stick to berate (punish) the organic brigade; branding them as eccentrics that fertilize their crops with wee”.

Other Alternative P fertilizers (APFs)

In Figure 6, three remaining fertilizer products that are currently permitted in OA are ranked in order of decreasing acceptability. Within each fertilizer product, the workshops are listed in order starting with the mean value, then the two international workshops, and then the countries arranged by decreasing acceptability in general, but in the same order within each type of product. Again, stakeholders from Denmark and Great Britain were overall the most positive or least skeptical, but this varied between the three fertilizer types. German and Austrian stakeholders were more positive towards rock P, but less towards meat and bone meal (MBM) than stakeholders from other countries. One respondent in the Biofach workshop expressed that “MBM feels disgusting, but it’s certainly needed to close the big cycle”. For basic slag, the acceptability was generally low, on average 40%, which is lower than for any other fertilizer product studied here except manure from fur animals. One respondent warned that basic slag may contain large concentrations of chromium (Cr). Another mentioned that MBM should be injected into the soil. For MBM, several mentioned that this is a conventional product, and should not be derived from factory farming (e.g. pig, poultry) when applied in OA. Preferably, applied MBM should be derived from organically managed animals. For rock P, one stakeholder mentioned that the acceptability was dependent on the country of origin.

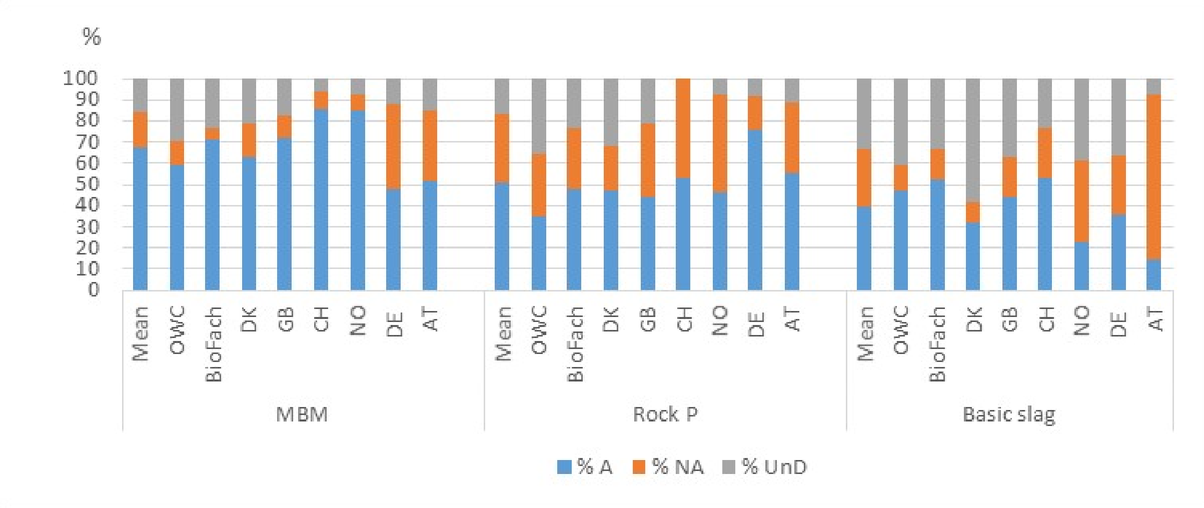


Figure 6. Acceptability of the fertilizers products meat and bone meal (MBM), rock P and basic slag (residual product from production of iron) in organic farming, assessed by stakeholders in different countries, explained in Table 2. Products regarded as acceptable (A) or not acceptable (NA) within organic farming standards, or undecided (UD). Products and workshops arranged with decreasing level of acceptance.

Effect of working position

Different groups of stakeholders assessed the different fertilizers somewhat differently (Fig. 7). Farmers were generally more skeptical than advisors and people employed by organizations, business etc. Scientists were notably skeptical towards the use of conventional animal manure, and more in favor of urban waste, human waste and other fertilizer products than the other groups. The differences between groups of stakeholders are not so significant that the presentation of opinions by workshop in Figures 2 and 3-7 seems to be unjustified because the proportions of stakeholder groups varied quite a lot from workshop to workshop (Table 2).

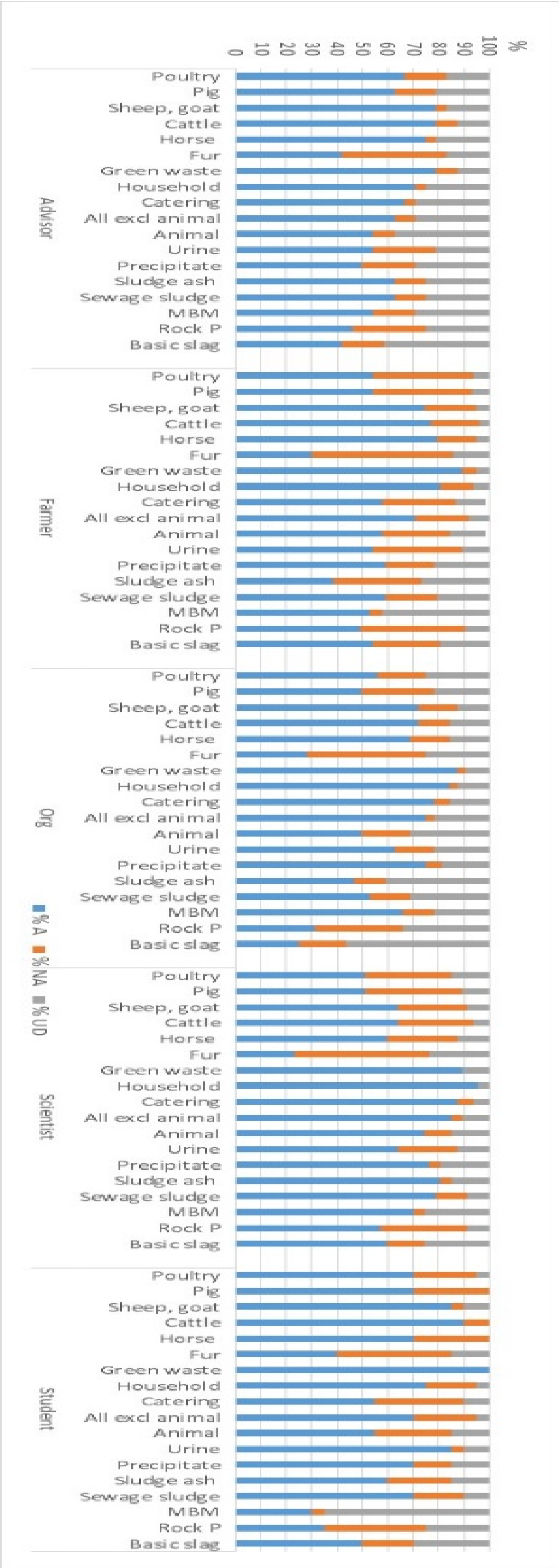


Figure 7. Acceptability of different fertilizers for groups of stakeholders: Advisors, farmers, people employed in organizations, business etc. (org), scientists and students.

What to choose?

On average across all workshops, the highest degree of acceptance was found for green waste, usually being composted, and the lowest acceptance for conventional manure from fur animals (Table 3).

Table 3. Average degree of acceptance for fertilizer products and substrates for composting or anaerobic digestion studied among organic sector stakeholder in various workshops, ranked from most to least accepted

Type of fertilizer product or substrate	% Acceptability by all stakeholders (average value)
Green waste (from recreational areas)	91
Source separated household waste	85
Food industry residues excluding animal residues	77
Conventional cattle manure	75
Conventional sheep and goat manure	73
Conventional horse manure	72
Meat and bone meal	72
Catering food waste	71
Precipitated P from human excreta	69
Food industry residues including animal residues	64
Human urine	64
Sewage sludge	63
Ashes from incinerated sewage sludge	56
Conventional poultry manure	56
Conventional pig manure	55
Rock P	54
Basic slag	43
Conventional manure from fur animals	31

This list of preferred or least preferred products can be compared to the output of the question where workshop participants were asked to rank 11 products, assigning each product with a value between 1 (**most** preferred) and 11 (**least** preferred), see Figure 8. The respondents were allowed to use the same number more than once, e.g. 1, 1, 2, 2, 2, 2, 4, 5, 6, 11,11. Different types of conventional manure were merged to “Conventional manure”, and food waste types except source-separated household waste was merged into the category “General food waste”. Further, it was possible to prefer on-farm P sources only, and basic slag was left out since this is rarely used.

The majority of respondents considered utilization of on-farm sources to be the best alternative (59 %), but 16 % found this to be the worst alternative, ranking it 11. This may be seen as an acknowledgement of the need of replacing exported P in organically managed soils. Again, green waste was the most popular fertilizer substrate, assigned with a rank of 1 by 33 % of the respondents. Very few assigned high rankings (= least preferred) to this product. In the ranking, human urine came out more positive than precipitation products, whereas for average degree of acceptance, precipitation products were more popular (Table 3, Fig. 5). Food waste was also quite popular, ranked as 1 by 22 % irrespective of source (Fig. 8), whereas only 19 % ranked conventional manure as the best alternative. Currently permitted products such as MBM and rock P were much less popular than food waste and human urine. The preference for rock P was comparable to sewage sludge and ashes from incinerated sludge; only 10 % of respondents found this to be the best alternative.

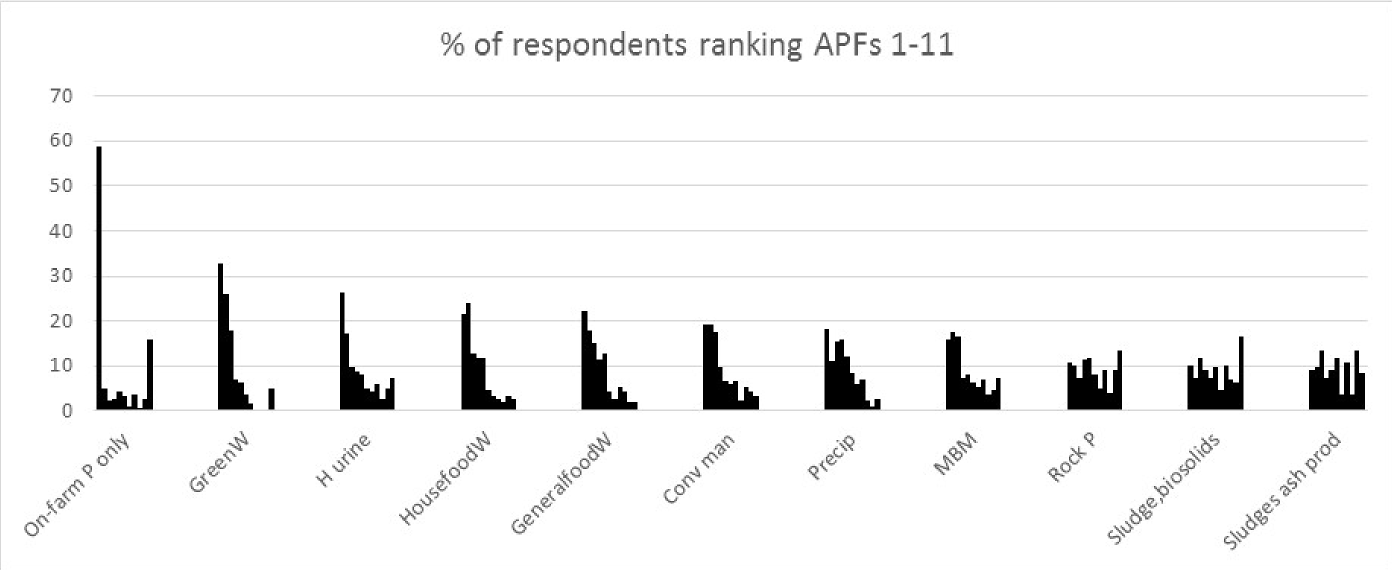


Figure 8. Proportion of respondents ranking various fertilizer products from 1 (most preferred; first bar in each series) to 11 (least preferred; last bar in each series), arranged by decreasing preference.

Agreement to statements

In the final question, respondents were asked to indicate their degree of agreement with seven statements about P supply to OA. The statements, with abbreviations used in Figure 9 shown in parenthesis, were as follows:

1) The P status of agricultural soils declines without the addition of supplementary P in purchased feed or fertilisers (Soil P down)
2) For most soils, adding rock P is an inefficient way to increase plant P availability (Rock P ineff)
3) In organic systems, recycling nutrients is more important than ensuring a completely contaminant-free final product (Recycl> food qual)
4) Permitting more recycled fertilisers in organic systems will damage the reputation of organic food (Bad image)
5) We need animals in organic systems to reduce the need for imported P fertilisers (Animals needed)
6) Precipitation products have high plant P availability, but no organic matter. Hence, their use must be combined with compost, green manures or other soil fertility building strategies to protect the humus (Prec +OM!)
7) Our modern wastewater treatment systems use large amounts of water and energy. Organic farmers should not use P fertilisers from these systems (H_2O toilet bad)

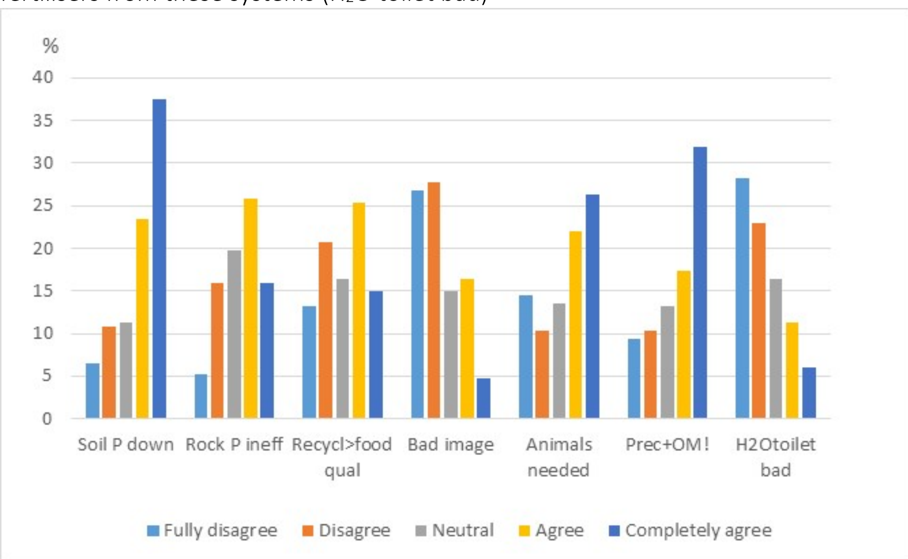


Figure 9. Agreement or disagreement to statements about P supply to organic farming systems. The complete texts of statements are referred above.

Some respondents commented that the answers to these questions were very dependent on the topics that had been communicated from invited experts. One respondent complained that the arguments presented from the experts were unbalanced, and not well enough adapted for an audience of (many) farmers. Another commented that the workshop informed her about possibilities, and motivated her to learn more. Expert presentations emphasized the need for recycling P to OA, and were generally positive towards the principle of recycling P, even if challenges e.g. heavy metal contents and GHG emissions were also presented. However, these questions can also be seen as they were in fact intended, to be a possibility for stakeholders disagreeing with the expert messages to present their conflicting opinions.

Food quality as such was never presented as a topic by any expert. An interesting result is that only 5% of respondents agreed completely, and 21% agreed that more recycled fertilizers in OA will damage the reputation of organic food (Fig. 9 "Bad image"). On the contrary, a majority disagreed in this statement. Further, 61% agreed (sum of completely agree and agree) that soil P status in OA will decline without external supply in feed and/or fertilizers. Only half of the respondents (48%) agreed that animals are needed in OA to reduce the need for imported P fertilizers. Half of the respondents disagreed that the modern toilet systems are inefficient and hence a reason to avoid products derived from human excreta, confirming the generally positive attitude towards some human excreta-derived fertilizer products found in this study. One stakeholder (Biofach, NL) commented to this question that wastewater systems can also be designed as a sustainable plant installation, and one from GB that "Sewage sludge is better used as enhanced treated biosolids from households". Another (Biofach, Israel) stated that as population expands, there will be more and more sewage and sludges to dispose. We should find legislative ways to permit the use of composted human sludges in organic farms. In line with this statement, a respondent from Great Britain stated that there "must be a way of "setting" human waste to an organic standard".

Personal comments

Personal comments were called for in the Q, and many utilized this possibility. Some concluding statements structured into central issues such as "Closing nutrient gaps", "Recycled N-fertilizers – an option in OA?", "Soil P" and "Pollution and toxic elements" are shown below. Where required, the statements were translated to English by the author of this report. In general, threshold limits for concentrations of heavy metals, organic pollutants etc., increased knowledge and thorough control were requested by many respondents for several waste categories. One respondent mentioned that this would push society forwards. However, another pointed to the enormous costs related to such control: "..but problems with monitoring and regulation may be insurmountable " (GB). Some asked for a broad assessment of recycled fertilizers, such as GHG emissions, eutrophication potential, consumption of energy, consumption of finite resources, soil pollution etc., and on the positive side, the efficiency of the fertilizer to promote soil fertility. Many also mentioned that conventional manure, food waste etc. should be composted, and one person stated that rock P should be included in the compost.

Several stated as explanation for not ticking "The workshop made me more positive.." that they were already well informed. It may be fair to ask if the workshops were arranged to convince stakeholders about accepting recycling of all kinds of P materials into OA. However, as this statement from Great Britain shows, different opinions were presented: "I knew very little about P systems before the workshop, and the ideas and opinions in the room were very conflicting, so I am not certain about the benefits of its use".

Generally about the workshop

"The workshop made me more positive towards recycled P fertilizers, provided that limits for toxic elements and guidelines on how to treat the products are available. I see large problems in the concentration of antibiotics in sewage sludge and human waste." (AT) Another stakeholder (DK) mentioned that processes for producing recycling fertilizers should minimize the input of additives.

"The workshop made me more positive towards recycled P fertilizers because there is now starting to come specific knowledge in this field". (DK)

"The workshop made me more positive towards recycled P because it seems that people in various countries deal with P recycling". (Biofach, DE)

"The workshop strengthened my opinion that recycled P fertilizer is required and achievable". (DK)

“I learned more about OA by the workshop. Now I am convinced that recycled fertilizers would be useful for OA, and can be in agreement with basic principles of OA”. (CH)

“The topic of the workshop is important and should be further studied”. (AT)

“It was very interesting to hear different opinions on recycled P-fertilizers. I learned a lot and am now motivated for further work and study of sustainable agriculture”. (CH)

“No doubt, more information, research and open discussions are needed. I believe that many farmers lack a consciousness about the challenges and perspectives related to future P fertilization”. (DE)

“The workshop made me more aware of the topic. O feel confident about these methods, and believe they could be used in agriculture, both conventional or organic”. (Biofach, NL)

“Toxic elements, loads of pollutions to the soil, soil organic matter, biodiversity, assessment of ecological impacts e.g. for energy consumption - are all considered. That is a very wide approach, which I find reasonable”. (CH)

“This workshop allowed me to make up a more differentiated opinion on P-recycling. Basically, I think that recycling should not stop with P, but comprise all nutrients (N, K, Mg, Ca etc.)“. (CH)

“Most impactful was the graph about the contaminant/nutrient ratio, and showing that some allowed materials have high contamination proportions as well. I still need to understand more about the techniques to treat sewage sludge and particularly whether they could qualify as “non-synthetic” “. (Biofach, DE)

“I did not know the relative levels of heavy metals (especially Cd) in various waste streams. What this shows is the need for stringent testing and removal of contaminants. This must be a condition of using the products of conventional systems and society. But this principle of "circularity" may be helpful in alerting wider society to the very EXISTENCE of these contaminants and building opinion to stop using/creating them in the first place, i.e. going organic”. (GB)

“I was already convinced that P must be recycled back for farm soil in the long run if OA shall be a sustainable alternative. The seminar gave me more knowledge on ways this can be done”. (Biofach, SE)

“The workshop did not make me more positive towards using recycled fertilizers in OA, but it made me more positive about using recycled P in conventional farming”. (GB)

Closing nutrient gaps

“Nutrient gaps should be closed, preferably on the holding itself, by cooperation with other holdings or on a regional level”. (AT)

“It is imperative to close the human nutrient cycle. Composting toilets should be an ultimate goal”. (Biofach, GB)

“On-farm P sources only are not realistic in the long run if you sell something from the holding”. (DK)

“On-farm P sources only is to prefer, but not sufficient”. (CH)

“Source-separated and catering food waste should derive from organic food if applied in OA, this is not realistic”. (CH)

“The (nutrient) cycling management should not end at the boarders of the holding. We should think further, and utilize P from residues”. (DE)

“It would be nice to be as locally sourced as possible. However, I am neutral on whether a lot of these "non-farm" products are acceptable in organic standards. On top of that I do not like the reliability we have on continued search for imported nutrients”. (GB)

“Minimising losses from the farm is paramount as it is the only action that can make better use of what P there already is. I strongly believe that the P in human waste before or after it has been ingested should not go to waste. I do see though that the credibility of organic farming is undermined by a reliance on inorganic farming and food leftovers and contamination”. (GB)

“There is a very limited supply of P in the world. It is not a renewing resource. We must therefore encourage use of P from recycled sources whenever possible. NB We should also be encouraging conventional agriculture to use P from these recycled sources!”. (GB)

Recycled N-fertilizers – an option in OA?

“I am quite positive towards recycled N-fertilizers e.g. derived from human waste because we should develop a “cycling” society”. (AT)

“This possibility should absolutely be further studied”. (CH)

“P should not be considered alone; instead we should aim for fertilizers that allow for a balanced nutrient application. If a soil or a crop is in demand of N, it should be possible to cover this demand by recycled products”. (CH)

“The EU legislation must be revised!”. (DE)

“I am quite positive towards recycled N-fertilizers e.g. derived from human waste as long as they are locally derived”. (AT)

“.. but we have to consider the required energy consumption. In general, it would be better to allow conventional mineral fertilizers”. (AT)

“Recycled N would contribute to close nutrient gaps, which is positive. Applied in soil, we will run into a discussion on how to differentiate OA from conventional agriculture. On the other hand, also animal manure contains mineral N”. (CH)

“I could accept a limited utilization of recycled N-fertilizers e.g. derived from human waste in OA even if this implies application of mineral N, e.g. in buckwheat to cover the N demand in certain crops. However, this implies a change of paradigm and is for the time being probably not acceptable”. (CH)

“Recycled N fertilizers means that we turn away from the organic idea of fertilizing the soil, not the plant, since this N would be readily available for plant uptake. In my mind, this is not reasonable” (CH)

“Sorry, but this is against the organic idea that we should fertilize the soil, not the plants. Hence I am negative, but basically I am in favor of utilizing by-products”. (CH)

“High concentrations of easily soluble (mineral) N are against OA”. (CH)

“Soluble recycled N should be applied in conventional agriculture”. (CH)

“Since N often limits yield, mineral N fertilizers from human waste may be applied in OA, but only in amounts not reducing the soil organic matter content”. (CH)

“Fertilization in OA has to include the management of soil organic matter (humus). Recycled fertilizers should maintain their contents of carbon. The C-dynamic is often limited on OA farms”. (CH)

Soil P

“In general: If organic farms are seeing a decline in P, then the system is not sustainable”. (GB)

“There is a large untapped potential of P already in soil. Increase organic content, labile P becomes available”. (GB)

“More research is required into making P in soil available, particularly green manures”. (GB)

“Ultimately for sustainability we have to replace P, lost off farm but balance between purity and recycling is a difficult one. We need to focus on making best use of P reserves in soil such as deep rooting green manures, efficient composting, P scavenging plants i.e. getting more P into the organic fraction. And sourcing less contaminated sources of P”. (GB)

“We should make more use of systems to make P in soil more available rather than bringing in P artificially”. (GB)

“I have not needed to use P on my organic farm. Perhaps the recommended P levels are still based on conventional recommendations. From my experience, both P & K levels can be at a much lower level than "the norm"; still get very good crop production”. (GB)

“There is in most soils a lot of unavailable P that first should be activated by improved soil management”. (GB)

Pollution and toxic elements

“What about all the pollution coming from traffic and the air?” (AT)

“We should increase our tolerance for heavy metals”. (DK)

“The “biocides” should be considered less important than the main goal of recycling P, but of course there are conditions that such fertilizers have to fulfil”. (CH)

“On-farm P sources only is obviously the best solution, if a good nutrient cycle can be established on the holding”. (NO)

“Food residues should be recycled to conventionally managed soil. Recycling nutrients is important, but it is not right to take from conventional agriculture and transfer to organic…”. (NO)

“Conventional animal manure should only be used in exceptional cases; by regular application is the concept of OA not fulfilled”. (CH)

“It is important to close nutrient gaps, but external conditions to support this must be present”. (CH)

Conclusions

The workshops were generally positively received, with satisfactory numbers of participants. In spite of a quite complicated questionnaire and strict limits of time, most respondents filled in the majority of information that was asked for, and many added personal comments that enriched the output of the study.

The respondents agreed with the need for closing nutrient gaps to ensure the long-term fertility of organic agriculture (OA), and a majority of stakeholders did not agree that permitting more recycled fertilizers in organic systems would damage the reputation of organic food. However, opinions differed about how well different recycled fertilizer products are adapted to OA. E.g. some stakeholders found all types of conventional manure to be acceptable, whereas others would only accept manure from high welfare and grass-fed systems, and a few would refrain from any form of animal husbandry and manure.

In general, green waste was the most popular fertilizer product, accepted by more than 90% of the respondents. Least popular was conventional manure from fur animals, but even for this material, more than 30% of the stakeholders were willing to accept its use in OA.

There is a large interest among organic stakeholders in fertilizer products derived from human excreta, provided these can be controlled to be safe with respect to food safety issues (pathogens, pharmaceuticals, heavy metals and other pollutants). More than 60% of the respondents accepted the use of human urine and sewage sludge in OA. Respondents realize that the mineral N that could accompany the P in such products, e.g. in struvite (ammonium-magnesium phosphate) may be controversial within OA. However, the need for recycling nutrients and organic matter may be a reason to adjust regulations for organic production and authorized inputs.

Rock P, which is currently permitted in OA, was less popular among the stakeholders than several currently non-permitted products such as fertilizers derived from human excreta, or food waste containing animal by-products.

In general, respondents from Great Britain and Denmark were more positive towards recycled P than stakeholders from other countries. Among the remaining four countries, it varied in which country the respondents were most negative. Respondents from Germany and Austria followed each other closely, and were the most negative towards conventional animal manure. Norwegian stakeholders were the most reluctant towards urban waste and products derives from human excreta except for urine. Swiss stakeholders were generally more positive towards recycled P fertilizers than respondents from other German-speaking countries, except for sewage sludge and ashes thereof.

The results of this study indicate that organic stakeholders are ready to accept more recycled P fertilizers into OA, as long as means are taken to ensure sufficient purity, safety and environmental efficiency of such products. This calls for adaptations in the regulations for authorization of fertilizers and soil amendments to certified organic production.

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Attachment 1

Questionnaire to record organic sector stakeholders' attitudes to alternative P fertilizers

Many organic farmers use phosphorous fertilizers from off-farm sources. We refer to these as 'alternative P fertilizers'. There are many different sources of 'alternative P fertilizers', some are allowed under specific circumstances and others are currently not allowed. This questionnaire is to assess organic sector attitudes to a range of allowed and currently not allowed 'alternative P fertilizers'**.**

Conventional animal manure

Conventional animal manure (from high welfare and non GMO feed systems) is currently allowed, usually with a composting treatment. Several organic stakeholders argue that conventional manure should be banned due to risks of pesticide residues, GMO, animal welfare issues and the need for organic farming to be independent from conventional systems. However, many organic farmers are dependent on this input, and conventional manure is a good P resource.

Urban organic waste

Waste from food production and consumption, as well as waste from gardens and recreational areas, contain significant amounts of P. When such waste is treated e.g. in compost plants or by anaerobic digestion it is sanitised and stabilised. Currently, only compost or digestate exclusively derived from specific slaughter wastes ('meat and bone meal'), recreational areas ('green waste') and/or sorted household waste is allowed in organic farming, which significantly limits the use of urban waste P. Catering food wastes, animal manure from factory farming and sewage sludge are potential further sources of substrate for compost and AD plants.

Human "manure"

Human urine and faeces, currently banned in organic farming, contain significant amounts of P and organic matter, but also may contain pathogens, heavy metals, pharmaceuticals and toxic residues. During treatment, various chemicals may be added e.g. to facilitate dewatering or precipitation.

Questionnaire to assess stakeholders' opinions about P fertilization in organic farming, as a part of the Improve-P project

In which country do you work? ....Gender: ………………Age: …………Profession (please tick or circle around what comes closest)

Farmer/producer Advisor Certification sector Scientist Business sector Other, please specify: ………

Which to choose? Which materials do you think should be acceptable fertilizers within organic farming standards? **Please do not feel restricted by current standards!**

Conventional animal manure

Source of manure	**Acceptable**	**Not acceptable**	**Undecided**	**Specifications (e.g. AD, composted, GM risk, welfare system)**
Poultry				
Pigs				
Sheep and goats				
Cattle				
Horses				
Fur animals				

Urban waste products

Source	**Acceptable**	**Not acceptable**	**Undecided**	**Further comments (e.g. AD or composted)**
Green waste from recreation areas				
Source separated household food waste				
Catering food waste (e.g. institutional, restaurant trade)				
Food waste from food processing industry, excluding animal products				
Food waste from animal products e.g. abattoir				

Products originating from human waste

Product	**Acceptable**	**Not acceptable**	**Undecided**	**Further comments**
Source-separated human urine				
Precipitation products from waste water treatment (e.g. Crystal Green)				
Sewage sludge/biosolids				
Sewage sludge ash				

Other alternative P fertilisers

Type of source	**Acceptable**	**Not acceptable**	**Undecided**	**Further comments**
Meat and bone meal				
Rock P				
Basic slag				

Summing up, which P sources you would prefer? Please give a ranking from 1 for what you prefer most, to maximum 11. You can use the same number more than once (e.g. 1,1,1,2,3,4,4,5,11,11,11 or 1,2,3, 4,5,6,7,8,9,10,11).

Type of source	**Ranking (1 - 11)**	**Comments including any specifications about the type of source**
Human urine		
P precipitated from waste water (e.g. Crystal Green)		
Solid sewage sludge (biosolids)		
Sewage sludge ash		
Household waste (either compost or digestate)		
General food waste (either compost or digestate)		
Green-waste (either compost or digestate)		
Meat and bone meal		
Conventional animal manure		
Rock-P		
On-farm sources of P only		

Silly or reasonable statements?

Please indicate how much you agree or disagree with the statements below by selecting a score for each between 1 (Fully disagree) and 5 (Fully agree). 3 = Neutral, 0 = No opinion.

Statement	**0 No opinion**	**1 Fully disagree**	**2 Slightly disagree**	**3 Neutral**	**4 Slightly agree**	**5 Fully agree**
The P status of agricultural soils declines without the addition of supplementary P in purchased feed or fertilisers						
For most soils, adding rock P is an inefficient way to increase plant P availability						
In organic systems, recycling nutrients is more important than ensuring a completely contaminant-free final product.						
Permitting more recycled fertilisers in organic systems will damage the reputation of organic food.						
We need animals in organic systems to reduce the need for imported P fertilisers.						
Precipitation products have high plant P availability, but no organic matter. Hence, their use must be combined with compost, green manures or other soil fertility building strategies to protect the humus.						
Our modern wastewater treatment systems use large amounts of water and energy. Organic farmers should not use P fertilisers from these systems.						

Has your opinion changed?

Opinions may change when people receive new information, and engage in discussions with persons they respect. Former opinions may be clarified, strengthened or weakened. Do you think that your opinions about P fertilization in organic farming have changed after attending the Improve-P workshop and answering these questions? **Please tick ONE answer !**

The workshop did not have any impact	
The workshop made me more positive about the use of recycled P fertilizers in organic farming	
The workshop made me more skeptical about the use of recycled P fertilizers in organic farming	

Please explain in a few words why you ticked your chosen alternative above. Please also write other comments about the issue of P in organic farming that you would like to communicate to the project team. Please continue overleaf.

Thank you so much for your kind contribution to our research! *More information at https://improve-p.uni-hohenheim.de*

Further enquiries or comments to: the Newcastle University/ NEFG stand or if you complete this after the Soil Symposium to: NEFG, Stocksfield, Northumberland NE43 7XD or Julia.Cooper@newcastle.ac.uk, anne-kristin.loes@bioforsk.no or Kate.Gascoyne@newcastle.ac.uk

Attachment 2

Program for the workshop at OWC, Istanbul, Turkey October 2014

OWC workshop: Re-use the phosphorus!

We invite you to discuss recycling of P in organic agriculture.

We will present different options to treat and use permitted as well as currently non-allowed phosphorus (P) fertilizers from urban areas. We need to discuss how we can increase the use of recycled P in organic farming systems, without compromising a premium product quality and the long- term sustainability of organic farming.

Researchers from a European project, Improve-P will present current knowledge about the P status of organic farming systems and the availability and quality of recycled P fertilizers.

CORE Organic II project:

Assessment of the suitability of recycling phosphorus fertilizers for organic farming

Improve-P

https://improve-p.uni-hohenheim.de

http://www.coreorganic2.org/

Duration 2013-2016

Program:

Welcome to the workshop and introduction to the Improve-P project
Dr. Anne-Kristin Løes, Bioforsk Organic Food and Farming,Norway

When do we need additional P fertilizers in organic agriculture?
Dr. Julia Cooper, University of Newcastle

Sewage sludge, human urine, digestate, compost…What do we want to apply? Developing waste treatment technologies implies new possibilities for organic agriculture
PhD-student Gregor Mayer, ETH and Dr. Paul Mäder, FiBL, Switzerland

Off-farm P fertilizers: Potential risks and how to ensure soil and product quality?
Dr. Jürgen K. Friedel, University of Natural Resources and Life Sciences Vienna, Austria

Discussion, conclusions and answers to a simple questionnaire

Venue: 18th OWC, Istanbul, Turkey, Tuesday October 14, 2014, time 11:30-13:00.

Contact: Dr. Anne-Kristin Løes, Bioforsk Organic Food and Farming, Gunnars veg 6, N-6630 Tingvoll, Norway. E-mail anne-kristin.loes@bioforsk.no Phone +47-404 79 962

Anne-Kristin Løes is leading the Improve-P WP4, "Stakeholder perceptions about applicability of alternative P fertilizers in organic farming".

Attachment 3

Program for the workshop at the National Soil Symposium, Solihull, GB, November 2014

Workshop: 1.30pm – 2.45pm 'Facing up to the phosphorous challenge'. Chair: Liz Bowles.

Research Project - Improve P: Assessment of the suitability of recycling phosphorus fertilisers for organic farming CORE Organic II project (2013-16). The aim of the workshop is to provide up to date information and receive guidance from British stakeholders on their opinions towards alternative P fertilisers. The information will be provided in a short presentation from the research project team (Julia and Anne-Kristin) + Dr Dan Froehlich, Ostara. The stakeholders' opinions will be used to guide further actions in the Improve P project with regulatory bodies and other relevant stakeholders.

The scientific background is that soil P is a non-renewable and scarce resource. Soil P status may decline over time in organic farming systems aiming for self-sufficiency, and there is a need to close the P cycle to get more of the P exported from farmland back to the soil. Current regulations, being EU standards or stricter regulations by various certification bodies, are not well adapted to the rapidly changing situation in Europe, where organic waste technology now includes products such as precipitated struvite from urban waste water, or anaerobically digested food waste. Fertilisers derived from human waste are not permitted and there are strict requirements for which substrates may be included for digestate and compost. This has led to different practices in different European countries with respect to the utilisation of organic waste in agriculture in general, as well as in organic agriculture. To change the P flow from a stream to a (re)cycle, we need adjustments in regulations and standards. To enable actions on this, we need to know what stakeholders think about various alternatives. The project also embraces agronomical practices such as P efficient varieties and crop rotations, efficient microorganisms etc., which will also be included in the information presentation.

In 75 minutes, what do we want farmers and growers to gain from attending this session?

☐ Understand practical approaches to improving crop uptake of P, including varietal choice and the use of inoculants.

☐ Learn about a variety of alternative P sources on farm.

☐ Be aware of innovative initiatives to recover P from waste systems, with clarity on which are and are not currently permitted in organic systems.

☐ We will also request feedback and facilitate discussion on the issue of using alternative P sources, including products from human wastes as fertilisers on organic farms. Participants will be requested to complete a questionnaire expressing their views after hearing from the specialists and the workshop discussion.

Time	Activity	Key Points/Comments
3	Introduction to why this is an issue by Liz Bowles	Mention that there are many experienced people in the room who will be available to answer questions and introduce panel members. Show of hands on who are farmers and growers/other supply chain/ advisers/ academics.
30 mins	Presentation by Julia Cooper and Anne-Kristin Løes. As the audience is predominantly organic farmers and growers, they are interested in products permitted for use in organic farming systems in this section. This needs to be very focussed on what they can use now and not what they can use in the future. Include in here 5 mins for clarification questions	Introduction to the workshop – the questionnaire can be mentioned but this should not be the focus within this bit. The questionnaire is introduced properly later on. • Identify organic farming systems that are likely to be running a P deficit (AK) • Practical approaches to improving crop uptake of P, including varietal choice and the use of inoculants (AK) • The potential to use a variety of alternative P sources on your farm (JC) Discuss the issue of using human wastes and other alternative P sources as fertilisers on organic farms and outline some of the risks involved (JC)
5 mins	Presentation by Dan Froehlich	Short introduction on the Ostara product as a case study - how the product is made, its attributes and regulatory status in Europe/UK
35 mins	15 mins: Introduction to the questionnaire and context. Work on the questionnaire and discuss with neighbour. 20 minutes: Q &A session –including presentations and questionnaire	Peter Melchett and Sarah Hathway will be able to help respond to queries from a policy/certification perspective. Carlo Leifert, Liz Stockdale and Mark Measures on technical and farm situations.
2mins	Liz Bowles	Summary and Close

Attachment 4

Program for the workshops at Biofach, Nuremberg, Germany, February 2015 and WiTa, Eberswalde, Germany March 2015

Improve P: Assessment of the suitability
of recycling phosphorus fertilisers
for organic farming

CORE organic II

IMPROVE

Workshops in Germany at Biofach Wissenschaftsforum

Dates and venues:
February 13, 10:00-11:30, Room Prag, NCC Ost, Nürnberg Messe (Biofach).

Background: The Improve P project (2013-16) will develop and evaluate strategies for increased recycling of P and other nutrients in organic farming systems (https://improve-p.uni-hohenheim.de/). Long-term organic farms often show a decrease in soil P levels, which may be balanced by recycled fertilisers in addition to adoption of improved agronomic strategies to enhance crop P uptake e.g. by application of plant growth promoting rhizobacteria. Six European countries cooperate in the project, Austria, Denmark, Norway, Switzerland, UK and Germany. The coordination is by Dr. Kurt Möller at the University of Hohenheim. Dr. Anne-Kristin Løes from Bioforsk Organic Food and Farming, Norway leads the work package focussing on stakeholder opinions. Dr. Stephanie Fischinger, leader of Bioland research and development, has kindly agreed to assist Improve-P in the biofach stakeholder workshop.

The aim of the workshops is to present the current knowledge about the need for P input in organic farming and about possible recycled fertilisers, and further to receive guidance from German and international stakeholders on their opinions towards alternative P fertilisers. The stakeholders' opinions will be recorded by help of a questionnaire, and will be used to guide further actions in the Improve-P project towards regulatory bodies and other relevant stakeholders.

The scientific background is that soil P is a non-renewable and scarce resource. Soil P status may decline over time in organic farming systems aiming for self-sufficiency, and there is a need to close the P cycle to get more of the P exported from farmland back to the soil. Current regulations, being EU standards or stricter regulations by various certification bodies, are not well adapted to the rapidly changing situation in Europe where organic waste technology now includes products such as precipitated struvite from urban waste water, or anaerobically digested food waste. Fertilisers derived from human waste are not permitted, whereas for digestate and compost, there are strict requirements for which substrates that may be included. This has lead to different practices in different European countries with respect to the utilisation of organic waste in agriculture in general, as well as in organic agriculture. To change the P flow from a stream to a (re)cycle, we need adjustments in regulations and standards. Then we need to know what stakeholders think about various alternatives.

The structure of the workshop will be that participants divide into small groups of 5-8 persons, preferably around tables, after the introductions with clarifying questions. The questionnaires (Qs) will be filled in individually during this group work, while discussing the Q and how to fill it in. Discussions between the participants in how to understand the questions, and to clarify what to tick or respond, are very much welcomed. However, it is not an aim to come to agreement. Different opinions are welcomed. We hope that insights into which kinds of APFs are most promising, and what kind of knowledge do we need to come further, will be the output of the workshops.

More information about the projects and the workshops are found on the project website at www.improve-p.uni-hohenheim.de . The detailed program for the first event (Biofach workshop) is available below. For the Wissenschaftstagung-workshop, the program will be adapted to the available time slot.

With friendly regards from the workshop organisers

Kurt Möller Anne-Kristin Løes Stephanie Fischinger

Biofach Wisssenschaftsforum - February 13, 2015

Recycling phosphorus fertilisers: Should we change organic regulations?

- Dr. A.-K. Løes (chair): Welcome to the workshop. Why do we need recycled P fertilisers? (10 minutes)
- Dr. Kurt Möller: Which recycled P fertilisers are available, and what challenges do we face by a possible introduction of these info organic farming systems? (20 minutes)
- Dr. Stephanie Fischinger: Viewpoints from a German farmers association on the use of recycled P fertilisers in organic farming (10 minutes).
- 10 minutes in plenary for clarifying questions and initial comments to the introductions
- 5 minutes to hand out and present the questionnaire
- 25 minutes for group discussions and filling in of the questionnaires
- 10 minutes for short feedbacks from some of the groups and for the chair to summarise the workshop.

Attachment 5

Program for the workshop at Organic 3.0, Røros, Norway, November 2015

PROGRAM FOR WORKSHOP 7, RESIRKULERT GJØDSEL

9:00-9:10 Velkommen til fosfor-workshop! Anne-Kristin Løes

9:10-9:30: Status for P globalt og nasjonalt, og potensialet for P-gjødsel fra organisk avfall i Norge. Ola Stedje Hanserud
Spørsmål og diskusjon

9:45-10:00 Bruk av råtnerest fra biogassproduksjon i økologisk dyrking. Grete Lene Serikstad
Spørsmål og diskusjon

10:15-10:35 Behovet for P i økologiske dyrkingssystem, restriksjoner på bruk av resirkulert P gjødsel i dagens regelverk, og introduksjon til spørreskjema. Anne-Kristin Løes

10:35-11:15 Deltakerne inkludert Ola og Grete Lene fyller ut et spørreskjema til bruk i Improve-P prosjektet, mens de diskuterer med hverandre i mindre grupper
11:15-11:45: Avsluttende diskusjon om resirkulert gjødsel og bruken av dette i økologisk landbruk

Attachment 6

Program for the workshop at FiBL, Frick, Switzerland November 2015

WORKSHOP

FiBL

Forschungsinstitut für biologischen Landbau
Institut de recherche de l'agriculture biologique
Research Institute of Organic Agriculture
Istituto di ricerca dell'agricoltura biologica
Instituto de investigaciones para la agricultura orgánica

Expertenworkshop über Phosphor Recyclingdünger in der Biolandwirtschaft

Datum
Dienstag, 24. November 2015, 9:00 bis 16.30 Uhr

Aula, Forschungsinstitut für biologischen Landbau, FiBL, Ackerstasse 113, 5070 Frick

Inhalt
In der organischen Landwirtschaft ist ein langfristiges Phosphormanagement eine entscheidende Aufgabe, um dem Ziel näher zu kommen, Phosphorkreisläufe weitgehend zu schliessen. Die organische Landwirtschaft beruht auf der effizienten Nutzung und Wiederverwertung von bestehenden Ressourcen. Aktuell gehen grosse Mengen an Phosphor durch ineffiziente Rezyklierung organischer Abfälle verloren. Die Wiederverwertung von Phosphor aus Stadtgebieten und der Lebensmittelindustrie und dessen Rückführung auf landwirtschaftlich genutzte Flächen stellt eine dringende Notwendigkeit dar.
In diesem Workshop werden verschiedenen Möglichkeiten diskutiert, wie zugelassene und aktuell nicht zugelassene Phosphor Recyclingdünger genutzt werden können und wie ihr Gebrauch gesteigert werden kann, ohne dabei die Qualität der Produkte und die Nachhaltigkeit organischer Landwirtschaftssysteme zu beeinträchtigen. Weiter sollen Risiken und Chancen aufgezeigt werden, welche entscheidend die Anwendung von Phosphor Recyclingdüngern beeinflussen.

EXCELLENCE FOR SUSTAINABILITY

Das FiBL hat Standorte in der Schweiz, Deutschland und Österreich
FiBL offices located in Switzerland, Germany and Austria
FiBL est basé en Suisse, Allemagne et Autriche

FiBL Schweiz / Suisse
Ackerstrasse 113, Postfach 219
CH-5070 Frick
Tel. +41 (0)62 865 72 72
info.suisse@fibl.org, www.fibl.org

Programm Dienstag 24. November 2015

Zeit	Thema	ReferentIn
9.00	Ankunft	
9.15	Begrüssungswort und Vorstellungsrunde	P. Mäder
9.25	Einführung in das EU-Forschungsprojekt Improve-P[1]	K. Möller
9.45	Pflanzenverfügbarkeit des Phosphats in Recyclingdüngern	A. Oberson
10.00	Alternative Phosphor Düngerstrategien in Kombination mit Bioeffektoren – Einblicke in das EU-Forschungsprojekt BIOFECTOR[2]	S. Symanczik
10.15	Kaffeepause	
10.30	Möglichkeiten des Phosphor-Recyclings aus Urin	K. Udert
10.45	Karbonisierter Klärschlamm als Phosphor Recyclingdünger?	R. Krebs
11.00	Phosphorrückgewinnungstechnologien und deren Bewertung: Das EU-Forschungsprojekt P-REX[3]	J. Stemann
11:15	Diskussionsrunde 1	
12:00	Mittagessen	
13:00	Die Notwendigkeit einer Phosphor Düngung in organischen Landwirtschaftssystemen	A.-K. Løes
13.15	Regionalisierung von Nähr- und Schadstoffbilanzen: die Anwendung von Phosphor Recyclingdüngern im regionalen Kontext	A. Keller
13.30	Risiken von Recyclingdüngern in der Landwirtschaft aus Bodensicht	R. von Arx
13.45	Strategie der Bio Suisse für die Zulassung von Recyclingdüngern	C. Fankhauser
14.00	Rolle von Recyclingdüngern und ihre Anwendung im Biolandbau	M. Koller/H. Dierauer
14.15	Diskussionsrunde 2	
15.00	Pause	
15.15	Einführung Fragebogen	A.-K. Løes
16.15	Schlussbemerkung	
16.30	Ende des Workshops	

[1] Improve-P: Improved phosphorus resource efficiency in organic agriculture via recycling and enhanced biological mobilization
[2] BIOFECTOR: Resource Preservation by Application of BIOefFECTORs in European Crop Production
[3] P-REX: Sustainable sewage sludge management fostering phosphorus recovery and energy efficiency

Referentinnen und Referenten
- Paul Mäder, Leiter Departement Bodenwissenschaften, FiBL, Frick, Schweiz
- Kurt Möller, Wissenschaftlicher Mitarbeiter Fachgruppe Düngung und Bodenstoffhaushalt, Universität Hohenheim, Stuttgart, Deutschland
- Anne-Kristin Løes, Wissenschaftlerin Fachgruppe Organic Food and Farming, Bioforsk Norwegian Institute of Agricultural and Environmental Research, Norwegen
- Astrid Oberson Dräyer, Dozentin und Wissenschaftlerin am Institut für Agrarwissenschaften, Gruppe für Pflanzenernährung, ETH Zürich, Schweiz
- Sarah Symanczik, Wissenschaftliche Mitarbeiterin Departement Bodenwissenschaften, FiBL, Frick, Schweiz
- Kai Udert, Gruppenleiter Abteilung Verfahrenstechnik, Wasserforschungsinstitut, ETH, Dübendorf, Schweiz
- Rolf Krebs, Zentrumsleitung Natürliche Ressourcen, ZHAW Life Sciences und Facility Management, Wädenswil, Schweiz
- Jan Stemann, Wissenschaftlicher Mitarbeiter Institut für Ecopreneurship; Fachhochschule Nordwestschweiz; Muttenz, Schweiz
- Armin Keller, Wissenschaftlicher Mitarbeiter Nationale Bodenbeobachtung NABO, Institut für Nachhaltigkeitswissenschaften INH, Agroscope, Zürich, Schweiz
- Andrea Ulrich, Wissenschaftliche Mitarbeiterin Fachbereich Agrarumweltsysteme und Nährstoffe, Bundesamt für Landwirtschaft BLW, Bern, Schweiz
- Roland von Arx, Sektionschef Abteilung Boden, Bundesamt für Umwelt BAFU, Bern, Schweiz
- Christoph Fankhauser, Sachbearbeitung Bereich Landwirtschaft, Bio Suisse, Basel, Schweiz
- Hansueli Dierauer, Wissenschaftlicher Mitarbeiter Departement für Beratung, Bildung und Kommunikation, FiBL, Frick, Schweiz
- Martin Koller, Wissenschaftlicher Mitarbeiter Departement für Beratung, Bildung und Kommunikation, FiBL, Frick, Schweiz

Auskunft, Leitung des Workshops
Paul Mäder, Departementsleiter Bodenwissenschaften, paul.maeder@fibl.org ,
Tel. 062 865 72 32

Verpflegung
Individuell im FiBL Restaurant

Anmeldung bis 6. November 2015
Per Post oder Fax mit dem beiliegenden Anmeldetalon oder online über
www.anmeldeservice.fibl.org

Attachment 7

Program for the workshop at the National Organic Congress, Denmark November 2015

PROGRAM FOR WORKSHOP C2:
Nye veje til at sikre P-forsyningen

IMPROVE

Centrale spørgsmål
- Hvordan udvikler P-indholdet i jorden sig over tid på de økologiske bedrifter?
- Er der potential i P-effektive kornsorter og kartofler?
- Kan økologien fastholde sit gode renommé i befolkningen, hvis de økologiske afgrøder bliver gødet med f.eks. menneskelig afføring?

16:20-16:35 Behovet for fosfor i økologisk jordbrug, og forskningsprojektet Improve-Ps arbejde med mulige løsninger
Seniorforsker Anne-Kristin Løes, NIBIO

16:40-17:00 P-effektive sorter, fosfatløsende mikroorganismer og aktuelle P-kilder
Professor Jakob Magid

17:00-17:30 Deltakerne fyller ut et spørreskjema til bruk i Improve-P prosjektet, mens de diskuterer i mindre grupper
17:30-17:45: Avsluttende diskusjon om resirkulert gjødsel og bruken av dette i økologisk landbruk

- » Forside
- » Materialer/video
- » Præsentationer/sammendrag
- » Program
- » Projekter
- » Arrangør
- » Om kongressen
- » Historie
- » For de unge
- » Oplægsholder/ordstyrer
- » Udstilling
- » English
- » Kontakt

Program

Du kan downloade kongresinvitationen med program her (pdf, sept. 2015).
Se præsentationer og sammendrag fra mange af møderne her.

Dag 1, onsdag den 25. november 2015

09:00-10:00	Registrering og kaffe/brød
10:00-11:00	**Plenum 1:** Økologi som løftestang for fællesskab og udvikling *Oplæg v. Borgmester Mette Touborg, Lejre Kommune* Læs mere ›
11:00-11:30	Pause.
11:30-13:00	**Mødeblok A:** Blok A: Økogiens samfundsværdi – succes og udfordringer *Indledning v. Direktør Niels Halberg, ICROFS og introduktion til A1-A5* **A1** MILJØ Debat og afstemning: Hvordan kan økologien gøre det bedre for miljøet?

NYHEDER

Tilmeld nyhedsbrev

Vil du have informationer om Økologi-Kongres 2015, så tilmeld dig nyhedsbrevet.

Følg os på Facebook

Formand Hans Erik Jørgensen, Økologisektionen, Landbrug & Fødevarer:
"To gode og inspirerende dage"
"Gode faglige input"
"Deltagerne har sikkert fået en masse med sig hjem"

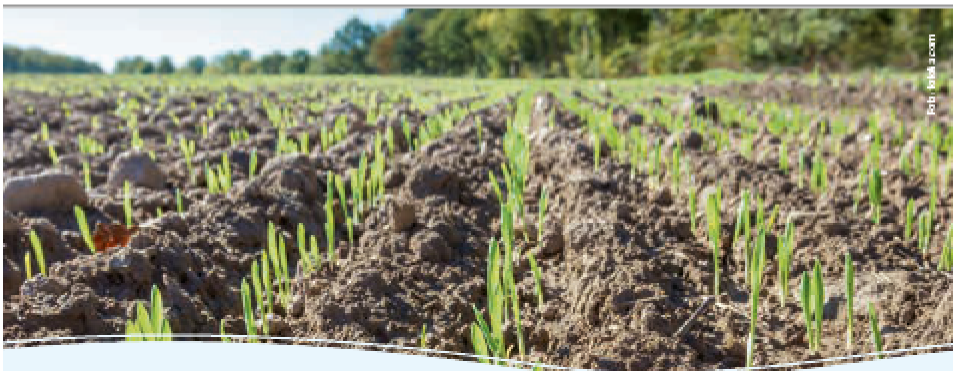
Formand Per Kølster, Økologisk Landsforening:

Attachment 8

Program for the workshop at BioAustria Bauerntage 2016, Wels, Austria January 2016

Programm

- Løes: Warum brauchen wir zusätzliche P-Düngung im Ökolandbau?
- Friedel, Weissengruber: Welche Risiken können durch die Anwendung von Recycling-D
- Hörtenhuber: Wie schaut die Energiebilanz der Recycling-Dünger aus?
- Diskussion
- Äußern Sie Ihre Meinung über Recycling-Dünger in unseren Fragebögen!
- Abschlussbemerkungen, Diskussion



Mittwoch, 27. Jänner 2016

Workshop Phosphor-Recyclingdünger (15:40 Uhr)

In diesem Workshop werden Möglichkeiten vorgestellt und diskutiert, wie verschiedene Phosphor-Recyclingdünger genutzt und verwendet werden könnten, ohne dabei die Qualität der Produkte und die Nachhaltigkeit biologischer Landwirtschaftssysteme zu beeinträchtigen. Es sollen Risiken und Chancen aufgezeigt werden. Die Meinung der Teilnehmer zu Phosphor soll im „IMPROVE-P" Projekt als Orientierung für Empfehlungen zur Weiterentwicklung der Richtlinien und Standards der biologischen Landwirtschaft dienen.

Hintergrund: Phosphor ist ein nicht erneuerbarer und knapper Rohstoff. Die biologische Landwirtschaft beruht auf der effizienten Nutzung und Wiederverwertung von bestehenden Ressourcen. Das Ziel ist, Phosphorkreisläufe weitgehend zu schließen. Aktuell gehen jedoch große Mengen an Phosphor durch ineffiziente Rückführung organischer Abfälle verloren. Die Wiederverwertung von Phosphor aus Stadtgebieten und der Lebensmittelindustrie und dessen Rückführung auf landwirtschaftlich genutzte Flächen stellen eine dringende Notwendigkeit dar.

IMPROVE CORE organic II

Attachment 9

Program for the workshop at the Farmer's Conference of Bioland, Bad Boll, Germany January 2016

Dienstag, 26.01.2016 | 14.00 – 15.00 Uhr

Trocken- und Hitzestress – welche Möglichkeiten ... ung gibt es ...

In Jah ... er gegenü ... chs und Mi ... ro-

Dienstag, 26.01.2016 | 16.40 – 18.10 Uhr

Phosphor-Recycling im Ökolandbau

Phosphor aus natürlichen Ressourcen ist ein endlicher Rohstoff. Gerade im Ökologischen Landbau wird in den letzten Jahren viel darüber diskutiert, wie Bio-Betriebe negative P-Salden ausgleichen können. Dabei kommt das Thema P-Recycling immer wieder auf. Dr. Kurt Möller wird vom laufenden Projekt zum P-Recycling für den Ökolandbau berichten und dabei auf Inhalts- und Schadstoffgehalte, Düngewirkung und Umweltwirkungen verschiedener P-Recyclingdüngemittel eingehen.

Dr. Kurt Möller, Universität Hohenheim

Pflanzenbau

Attachment 10

Example of workshop introduction from project partners

Slides shown by Dr. Kurt Möller at the workshop in Bad Boll, showing significant proportion of organically managed soil with low P concentration (CAL), the largest pool of P in recycled nutrients being sewage sludge (“Klärschlamm”), poor availability of P from rock P, high Cd/P ratios in rock P and compost, and high GHG emissions from compost per kg P.

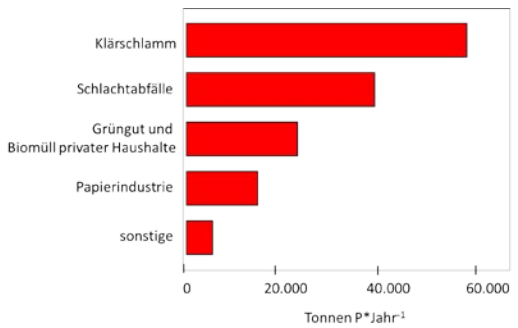
Aufteilung der P-Gehaltsklassen auf ökologisch bewirtschafteten Ackerflächen in Deutschland (Kolbe 2015)

Gehaltsklasse	A	B	C	D	E
P-Gehalt (mg P/100g Boden)*	< 2	2,1 - 4,4	4,5 - 9	9,1 - 15	> 15,1
Anteil der untersuchten Flächen	16 %	25 %	35 %	18 %	6 %

*Nach CAL-Methode

4

P-Potenziale alternativer P-Quellen in Deutschland (Fricke & Bidlingmaier 2003)



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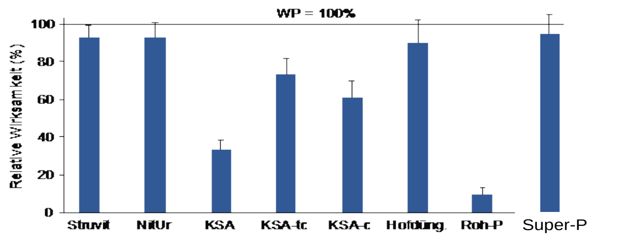
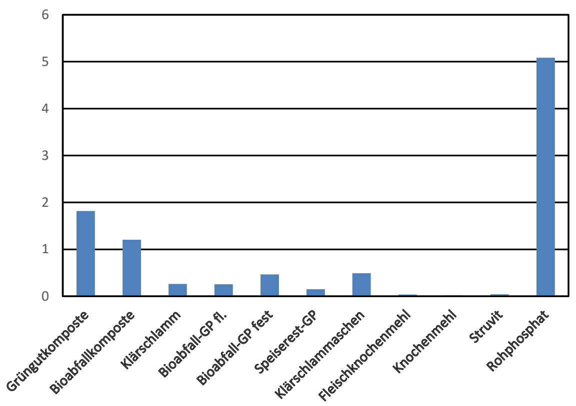
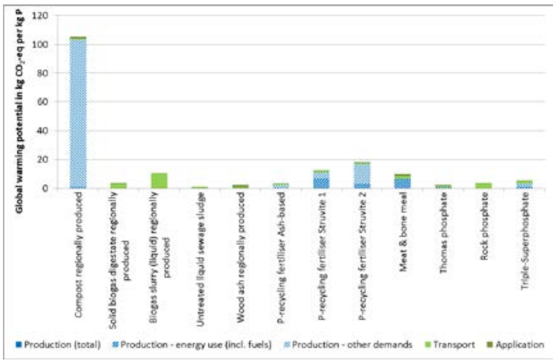


Oberson et al., 2010; Nanzer et al., 2014a; Bonvin et al., 2015

Cd/P-Verhältnis von altern. P-Düngemitteln



THG-Emissionen verschiedener P-Quellen je kg Phosphor (Hörtenhuber et al. 2016)



Project partners at the final meeting, May 2016, from left back row Sarah Zymanczik, Gregor Meyer, Leonidas Rempelos, Kurt Möller, Else Bünemann-König. Middle row: Anne-Kristin Løes, Astrid Oberson, Iris Wollmann, Jürgen Friedel. Front row: Jakob Magid, Julia Cooper, Paul Mäder, Bente Føreid, Stefan Hörtenhuber.

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