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Evolving Agriculture and Food Opening up Biodynamic Research

September 5th to 8th 2018 / Dornach, Switzerland

Conference Contributions

Editors: V. Wahl, A. Hach, S. Sommer, P. Derkzen, C. Brock,
J. Fritz, A. Spengler-Neff, U. Hurter, J.-M. Florin

Goetheanum

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Opening up Biodynamic Research

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WELCOME AND THANK YOU

Biodynamic research is carried out in every agriculture field and in many places around the world. It makes use of a broad range of methods and links to various other research areas such as agroecology. The *1st International Conference on Biodynamic Research, 5–8 September 2018*, adopted an inter- and transdisciplinary approach and brought together both academic research and farmers' expertise in order to explore and discuss the pressing issues in biodynamic food and farming systems. These issues were addressed both from traditional scientific and innovative methodological perspectives.

This booklet contains most of the abstracts of the papers and posters presented at the conference by over 100 researchers from all over the world. There are two categories of abstracts to facilitate contributions by both researchers and researching farmers and practitioners: scientific contributions and observation reports. Scientific contributions are based on the common standards for design, implementation and evaluation of scientific research, while observation reports open up the world of farmers' observations and experiences to the scientific sector. We believe that bringing these different sources of knowledge together is the best way to further explore and understand agricultural systems.

Our warm thanks go to all the authors and reviewers, the programme committee, the organisation team and partners, as well as the conference participants and sponsors. The conference would not have been possible without the cooperation of all these people.

Dornach, May 2019

Christopher Brock, Petra Derkzen, Jean-Michel Florin, Jürgen Fritz, André Hach, Ueli Hurter, Sarah Sommer, Anet Spengler-Neff, Verena Wahl

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INAUGURAL ADDRESS

Which research for biodynamic agriculture?

Hurter Ueli

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Compared to all other methods, approaches and movements, biodynamic agriculture has an important specific characteristic for a sustainable, ecological and regional agricultural and food culture: this being the principle of individualisation. We see the farm as striving towards individualisation. Based on anthroposophy, we see the human being as an individual in the process of development. And this principle of individualisation is also the driving creative force – whether conscious, partially conscious or unconscious – in the development of biodynamics.

This puts us on new agronomic and agro-social territory. Agriculture was of course always the area of life that required people to dedicate themselves to the local natural conditions, fitting in with the “Flurzwang” (compulsory crop rotation), fitting in with the investments of previous generations, fitting in with the family and the regional community, identifying with gender roles, particularly for women, etc. Individualising a farm in comparison with a neighbouring farm is a novelty and many biodynamic pioneers have fought and suffered bitterly for this. A community based on individual personalities connected by a common theme who take over and run a farm is a novelty, and each of us who is involved practically in a situation like this knows how challenging it is.

I therefore postulate that we need a kind of research – particularly in biodynamics – which presents, interprets, supports and develops this trend towards individualisation. I would like to think of this as a point of view, not as a demand, but nevertheless a point of view which stimulates and challenges us. And I say this both as a practical farmer and also as section leader. Because I have found that research in our present-day knowledge society is in danger of acting as THE creator of knowledge with a – please excuse the expression – almost religious claim to the sanctity of the results. Or, research also tends to become an industry with the researcher a kind of knowledge worker and the products mass-produced goods.

I believe that we need to cultivate a research culture between these two aberrations, one which attempts to do justice to the individual. And I hope and ask that biodynamic research will take its direction from this guiding star.

Now, every individuality is based on the presence of a soul, which is based on a living structure, and this in turn is based on a physical structure. I will attempt to classify our research endeavours according to these four levels.

On the physical level we have traditional scientific research, as agronomy. Data are collected on specific questions by measuring, counting and weighing in exact experiments with appropriate replications. The data set enables a statistical treatment and the results are intersubjectively and objectively guaranteed. This research is essential for the discourse in the scientific community, in fact it is the only entry code into this discourse community. The results obtained in this way are also an important basis for social and political participation. For the practitioner, this research can confirm through reliable data what he knows from his feelings and experience.

We require and are involved in a science of the living, because anthroposophy stipulates that the phenomenon of life requires its own level of reality, which it calls the etheric realm. The sensory phenomena, for example the forms of a plant over time or the crystallisation picture of a substance, are used to infer the etheric constitution and dynamics which underlie them. This approach, remaining true to the phenomenon but viewing it as created from the archetypal phenomenon has, under the name of Goetheanism, made an important and substantial contribution to researching the living reality for many years. There are also research approaches which look for a direct access to the etheric, for example rational formative forces research.

Investigation of the mental/emotional level is very important in biodynamics as we consider it indispensable to integrating the animal as a sentient being.

This mental/emotional dimension also includes the characteristics of the farm organism, the creation of landscape, everything connected to the atmosphere all the way to the social realm. Likewise the taste, smell and digestibility of the food. Research in this area is clearly strongly influenced by the personality of the researcher, and important innovations, such as mother-bonded calf rearing, really almost qualify as inventions. This is where research becomes developmental research.

Research and development on the individual level is essentially practical research. An individual in a specific place under particular conditions reaches a new level in the creation of reality. In terms of method this is very exciting. What actually happens when

someone takes up something in everyday life in such a way that it creates an individualised reality in a really innovative and exemplary way? This requires the ability to keep an inner distance and at the same time to remain engaged in the development with perseverance and full awareness. I believe that this is the way to develop a new type of wheat, fully developed dairy farming, a perfected preparation.

All four levels need and support each other. I see two goals for biodynamic research: first, it should open up the knowledge that we as bearers of the biodynamic impulse require as human beings and, second, it should enable us as a movement to contribute to the great challenges of the times in our field, but also beyond.

SOIL, PLANTS AND PREPARATIONS

SCIENTIFIC CONTRIBUTION

Effect of biodynamic preparations on the properties of soil and great pumpkin (*Cucurbita maxima* D.) fruits quality

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Securing quality and safety of food raw materials is an important challenge for Lithuania. Like for all vegetables, the quality and yield of pumpkin fruit depend not only on the species, variety, soil properties, and weather conditions but also on the cultivation technology applied. Pumpkin fruit does not accumulate high concentrations of nitrates and other pollutants; they are low in calories and rich in various antioxidants (carotenoids, phenols, anthocyanins and others).

Our research aimed to reveal the effect of biodynamic preparations on the properties of soil and on the quality of the great pumpkin fruit. Research done by foreign scientists has indicated that various plants whose cultivation technology included biodynamic preparations exhibited higher quality and better sensory properties and accumulated higher concentrations of antioxidant compounds. However, we found no research evidence on the effects of biodynamic preparations on the improvement of pumpkin fruit quality and on increasing of biologically active compounds content.

The study was aimed to explore and assess the effects of biodynamic preparations on the soil agrochemical composition, on the quality of the great pumpkin 'Justynka', 'Amazonka', 'Karowita' cvs. fruits. Soil composition and plant yield depend largely on the agricultural production system employed. Organic fertilizers and crop rotation applied in organic farms determine better soil quality indicators. In biodynamic farms, soil viability is maintained, special preparations are used, conditions are created for the production of products characterised by high quality and nutrition value. According our results the contents of

phosphorus, potassium, nitrogen and the activity of soil enzymes – urease and saccharase – during the entire vegetation period of the great pumpkin were significantly higher in the soil sprayed with P 500, than those in the untreated soil.

The use of the both preparations (500 and 501) had the greatest positive effect on the great pumpkin roots and leaf biometric parameters, chlorophyll index value and net photosynthetic productivity. The peel and flesh of 'Justynka' variety if compare with others cvs. contained significantly highest concentrations of dry matter and water-soluble carbohydrates. The use of P 500 and P 501 had a significant positive influence on the accumulation of dry matter, water soluble carbohydrates, crude fibre, the use of P 501 – on the accumulation of crude ash in the peel and flesh of pumpkin fruit tested. The flesh of 'Amazonka' variety if compare with others cvs. contained the highest concentrations of vitamin C, leuco-anthocyanins and total phenols. The spray-application of the P 501 had the greatest positive effect on the concentrations of vitamin C, leuco-anthocyanins, catechins and total phenols in the peel and flesh of the great pumpkin fruit. The fruit flesh of the 'Karowita' variety if compare with others cvs. was characterised by the highest contents of carotenoids, lutein+zeaxanthin, -carotene and catechins. The use of both preparations had a positive effect on the total carotenoid, lutein+zeaxanthin, lycopene and -carotene content in flesh for all great pumpkin varieties tested. The use of P 501 had a positive effect on accumulation for these compounds in seeds.

Our experimental findings proved that with the inclusion of biodynamic preparations in the cultivation technology it is possible to improve soil composition, to increase activity of soil enzymes, to enhance the nutritive value of pumpkin fruits. Moreover, they

provide preconditions for the development of novel cultivation technologies in Lithuania as well as for in-

novative outlook on harmonious interaction between man and nature.

SCIENTIFIC CONTRIBUTION

Achieving Microbial Balances in Soil through Biodynamic Agriculture Practices

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The production of food for humankind has been a tremendous challenge in the recent past. Sustainable agricultural practices have provided solutions to a certain extent in the Indian subcontinent with Organic and Biodynamic (BD) agricultural practices. The condition of our soil ultimately determines human health by serving as a major medium for food production, directly influencing the quality of food we eat. The health of our soil resources is a primary indicator of the sustainability of our land management practices, upon which human welfare depends. The uniqueness of Biodynamic agriculture depends on the use of biodynamic manures (cow horn manure and horn silica) and aerobic BD compost which comprise of six herbal inocula. These include fermented preparations of *Achillea millefolium* (BD 502), *Matricaria chamomilla* (BD 503), *Urtica dioica* (BD 504), *Quercus glauca* (BD 505), *Taraxacum officinale* (BD 506), and *Valeriana officinalis* (BD 507). While *Achillea millefolium* and *Quercus robur* are known to possess antibacterial and antifungal properties, *Matricaria chamomilla* and *Urtica dioica* are known to show antiviral effects too. The main objective of this research study was to assess the impact of different agricultural management practices and to achieve safe food production. The present study was carried out during the year 2016 by collecting

soil samples, from four different geographical locations of India. Conventional methodologies were adopted to detect the presence or absence of select food-borne pathogenic bacteria namely coliforms, *Salmonella species*, *Shigella species* and *Staphylococcus aureus* from BD and non-BD farms. Standard microbiological protocols using specific bacteriological media for the selective isolation of the bacterial flora were used. Three out of four bacterial pathogens namely, coliforms, *Salmonella* and *Shigella species* were isolated from Non-BD soil. The bacterial pathogens were undetected in BD soils. In view of this, the presence or absence of Coliforms, *Salmonella* and *Shigella species* as biological indicators has been considered. The current study is the first of its kind being reported from India. Collectively, the evidence supports the hypothesis that ecosystems managed by biodynamic agricultural methodologies are significantly safer in terms of food safety than conventional methods.

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- Stojanovic et al (2005)

Long-term, on-farm field manure experiment in Sweden comparing liquid and composted manure, including biodynamic treatments and biochar

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Research question

The goal of this long-term study is to identify effects of liquid manure compared to composted manure and evaluate biochar and biodynamic treatments.

Nibble farm converted to biodynamic farming in 1964 and soils have likely built up a long-term mineralization capacity similar to that documented in earlier long-term experiments and on-farm studies (Granstedt & Kjellenberg 2017). Soils are mainly sedimentary clay loam with SOM 2.5-4%.

Research methods

Experiments on Nibble, Järna, Sweden (59°N, 18°E) are an integrated part of crop rotation with winter wheat after legume-grass ley (3 and 2 years respectively) and incorporated into customary farm management practices with fall ploughing and seeding after legume-grass ley. Manure treatment of 30 tonnes ha⁻¹ corresponds to normal application.

Effects of applications of composted (CM) and liquid (LM) manure were studied at 3 levels of application: 0, 18, 30 and 50 tonnes ha⁻¹ with and without biodynamic preparation treatments (+BDP, -BDP) in a split-plot design, with replicates in 3 (experiment 1) and 4 (experiment 2 and 3) blocks. In experiment 1, established 2012, there is an additional reference plot with fresh farmyard manure (30 tonnes ha⁻¹) with and without BDP treatments. In experiments 2 and 3, established 2013, on half of the experimental area biochar (32 tonnes ha⁻¹) was incorporated together with manure treatments (+BC, -BC) but not randomized (NR).

Excel 2010 (Microsoft Corp USA) was used for calculations, graphics and statistical analysis. Design and ANOVA statistical analysis were according to Little and Hills (1978).

Results

In field experiment 1 average yield of cultivar 'Jaco-

by Borst' was 15% lower than 'Dacke' but 5% higher in +BDP composted manure treatments compared to -BDP ($p < 0.05$, $n = 9$). Average yield 'Jacoby Borst' in manured treatments was 15% higher compared to zero plots, similar manure effects was observed for subsequent yields of oats and legume-grass.

Field experiment 2 with 'Jacoby Borst' showed weak response to manure with average yield only 3% higher (n.s), but strong response to +BC with average yield 13 to 35% higher than plots -BC (NR, $p < 0.1$, $n = 12$). There was a tendency ($p < 0.1$, $n = 12$) towards effect of +BDP with CM, compared to -BDP. Harvest 2nd year was under poor weather conditions with no clear results. Third year first cut of legume-grass, manure 2013, was 5% higher. Biochar applied 2013 gave 14% average higher yield (NR, $p < 0.05$, $n = 32$), combined with +BDP an additional significantly higher yield of 6% ($p < 0.05$, $n = 12$) and combination effect of 21% higher yield.

Experiment 3 gave a weak direct effect on yield of wheat comparing with/without manure (3-6%) (n.s.). Average yield with +BC was over 11% higher ($p < 0.05$, $n = 12$).

Conclusions

Results show very low direct manure effect of both CM and LM. For LM, this can partly be explained by atmospheric loss of NH₄N. In experiments 2 and 3, a distinct effect of +BC was shown, with 8- 23% higher yield in soils with both high and low SOM, with effects seen up to 4 years after application.

First four years of Nibble experiment indicate that it is possible to observe differences between use or not of biodynamic preparations, in some cases supporting better yields (+ 5%) with CM with 'Jacoby Borst' and also with +BC in legume-grass ley (+6% and combined 21%). These results are in accordance with other on-farm field experiments (Granstedt & Kjellenberg 2017; Johnston & Poulton 2018).

The main explanation for weak direct manuring effect of organic manure is found in the long-term, inherent

soil mineralization capacity. The role of manure is to support this long-term effect (Gutser et al. 2005). Thus, manure only has a marginal effect on yield the year it is applied. Results at Nibble point to the importance of fertilizing soil instead of crops with long-term effects of manure, effects of BDP treatment, effect of biochar application and support for carbon sequestration using biochar.

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SCIENTIFIC CONTRIBUTION

Effect of biodynamic preparations on the soil biological and agrochemical properties and potato tubers quality

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Soil and crop management practices involving intensive use of synthetic fertilizers and pesticides in the cultivation/production of plant raw materials cause long-term adverse consequences related to the safety of food products and human health. As a result, the raw materials and products produced and handled without the use of chemical agents are increasingly appreciated by the consumers. Biodynamic agriculture is a unique system of organic agriculture which contributes to the development of the sustainable farming.

The aim of this research, which was undertaken in three years (2013–2015), was to evaluate the ef-

fect of biodynamic preparations 500 and 501 on soil biological and agrochemical properties and potato tuber quality. The field experiment was conducted on an organic farm in Prienai district (Lithuania). The experiment included two factors: I – three coloured potato cultivars (Red Emmalie, Vitelotte, Blue Congo), II – treatment with biodynamic preparations as field sprays (four treatments): 1 – preparations not used – control treatment; 2 – the soil was sprayed with preparation 500; 3 – potato plants were sprayed twice with preparation 501; 4 – the soil was sprayed with preparation 500, potato plants were sprayed twice with preparation 501. The soil samples were analysed for: available phosphorus and available potassium concentrations by the CAL method; ammonia nitrogen and nitrogen (sum of nitrate and nitrite nitrogen) concentrations by a flow injection analysis (FIA) spectrometric method; mineral nitrogen concentration was calculated as a sum of nitrogen (nitrate and nitrite) and ammonia nitrogen; soil reaction pH by a potentiometric method; activity of soil enzymes – urease and saccharase by the method of Hofmann and Schmidt. The potato samples were analysed for: total polyphenols content by the Folin-Ciocalteu method, anthocyanins by HPLC assay and antioxidant activity by the DPPH method.

The research revealed that significantly the highest

concentrations of available phosphorus, available potassium, nitrogen (sum of nitrate and nitrite nitrogen) and mineral nitrogen in the soil throughout the entire growing season were identified on the 14th day after soil application of preparation 500 (before potato planting). As well as, soil spray application of preparation 500 resulted in higher enzyme activity. Significantly higher activity of the tested soil enzymes was recorded 14 and 126 days after the spray application: urease activity increased by 25.0% and 40.5% respectively and that of saccharase – by 6.7% and 15.7%, respectively. The preparation 501 was found to exert the greatest positive effect on investigated biochemical constituents and their antioxidant activity in potato tubers with a colored flesh. When the preparation 501 was applied, the content of total

phenolic compounds in the tubers of cultivars Blue Congo and Red Emmalie was significantly higher, 20.1 and 5.4%, respectively; the content of anthocyanins were significantly higher in the tubers of all tested cultivars.

Our results indicated that the use of the preparation 500 stimulated the activity of soil enzymes saccharase and urease and increased the contents of nutrients important for plant growth (available phosphorus, nitrogen (sum of nitrate and nitrite nitrogen) and mineral nitrogen) in the soil. As well as, the application of the preparation 501 promoted and that of preparation 500 had a tendency to reduce the accumulation of biologically active substances and their antioxidant activity in the potato tubers with a coloured flesh.

SCIENTIFIC CONTRIBUTION

Yield and quality of *Daucus carota L.*, under biodynamic management, related to moon rhythms

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The history of the great civilizations of the past (Egyptians, Babylonians, Greeks, Incas, Aztecs) shows the importance of astronomical rhythms, not only in agriculture, but in all daily activities. In Brazil, traditional indigenous populations use this knowledge in agriculture. In biodynamic agriculture, Rudolf Steiner revalues this popular knowledge and extends it, incorporating the other rhythms of the moon, the movement of the planets and the Sun related to agricultural activities. In the International Biodynamic Movement, the best known astronomical / agricultural calendar is the one created by the farmer Thun, which is translated into several languages. In the scientific approach, some biodynamic researchers, such as Spiess (1994) and Goldstein (2000), studied the theme of chronobiology and cultivated plants.

The purpose of this work was to evaluate the influence of moon rhythms (synodic, sidereal, anomalistic, tropical and draconic) on yield, quality and post-harvest storage of *Daucus carota L.* roots under biodynamic management sowed in different dates. The

participatory research was carried out over a two period on a biodynamic farm, in Botucatu, São Paulo State, Brazil. Rhythms were tested observing the effects of seeding at different planting dates. The experiment was performed with four randomized blocks and 31 treatments (different dates) in 2005 and fourteen treatments in 2006. The harvest occurred 82 days after the sowing, when carrot roots show the most desirable aspect for the organic and biodynamic consumers. The magnitudes of effects associated with planting at a specific lunar position were measured by the deviations from the trend curve. The following characteristics were evaluated: fresh mass of roots and leaves, dry mass, diameter, length, nitrogen, phosphorus and boron content of the roots and perishability of the roots at 30, 60 and 90 days post-harvest. Dry mass was the only one that in the contrast between averages showed significant results in the two periods of the experiment. The new moon phase showed higher results than the crescent moon and full moon phases. In the two years of research, dry mass production at new moon was higher than full moon fase ($p < 5\%$). Goldstein (2000) and Spiess (1994) observed better results when the

carrot was sown one or three days before the full moon. It was clear that the synodic rhythm had the most significant influence. The draconic, sidereal and anomalistic had less influence and the tropical rhythm had no influence at all considering studied aspects. Considering M. Thun astronomical calendar, the results are not conclusive, because the "root days" were not the best for productivity. On the other hand the negative influence of node and perigee were noticed only at roots fresh matter measurements in 2005, and not in 2006. Botucatu city is located very close to the tropic of Capricorn and this position does not receive strong influence from tropical rhythms (highest and lowest moon) which is more intense in high latitudes and highly values at M. Thun studies. In Brasil the effect of the moon phases (synodic rhythm) is highly valued by family farmers and it was precisely the

aspect with more consistent statistical results.

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SCIENTIFIC CONTRIBUTION

Pfeiffer's circular chromatography test applied to soil samples and comparison to chemical analysis results

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Background

Paper chromatography is a widely applied analytical method for separation of liquid compounds. Pfeiffer's circular chromatography (PCC) test, relying on same principles, is a method applied mainly to qualitative soil analysis. PCC gets often applied by farmers themselves; however, is poorly studied in the academic ambient. In our experimentation, we tested whether the PCC test can differentiate between soil samples planted with different types of crops and deriving from different cultivation managements. The study was performed in frames of the project 'Panis cum Carne' financed by the Umbria Region / Italy.

Materials and methods

As described in [1] 16 soil samples from differently managed fields and planted with different crops were analyzed by means of PCC and chemical analysis. The PCC pattern evaluation consisted of three approaches: (i) measurement of pattern zones, (ii) visual scoring of pattern characteristics by schooled evaluators, and (iii) computerized texture analysis. Subsequently PCC results were correlated with the outcome of chemical soil analysis.

Results and discussion

Basing on correlations found the PCC pattern features may be grouped into two groups: (i) radial features (e.g. channels and spikes), peripheral zone breadth, color intensity, and texture parameter 'entropy' and (ii) concentric rings, total radius, and central zone radius. Group (i) correlated positively with the soil components related to high soil quality (e.g. organic matter, total nitrogen, phosphorus, bromine and sand) and negatively with the soils pH, and soil compactness

(e.g. contents of silt, and clay); on the contrary group (ii) correlated negatively with soil compounds related to high soil quality and positively with those responsible for soils compactness.

Conclusions

Our study may contribute to understanding of the pattern forming processes taking place during the

chromatographic imbibition and the working mechanisms of the PCC test. It shows further that the PCC test constitutes a valuable tool for qualitative soil analysis.

References

Pfeiffer's circular chromatography, soil quality, pattern evaluation, texture analysis, auto-organization, organic matter

OBSERVATION REPORT

Implementation and results of the biodynamic preparation prepared 500 (500P)

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Research question

Does the application of biodynamic preparations and in particular prepared 500 (500P) bring a visible and measurable change in soil functioning?

Research method(s)

Implementation of field trials under real conditions (agricultural) comparing biodynamic practices to biological controls. Evaluation of differences with the spade test (observation of soil colour and structure, root systems, water management in the soil), supplemented by classical analyses (organic matter, pH), and a dosage of microbial biomass and available nutrients,

observation of the plant over the season.

Results

Visual and analytical results confirm the rapid evolution of soils that received the biodynamic preparation 500P. They are clearly differentiated by a darker colour, a more aerated and crumbly structure. The analyses show very high levels of organic matter and of various nutrients compared to organic controls.

Conclusion

Changes due to biodynamic practices are visible and measurable within a few weeks or months and lead to more in-depth scientific follow-up in partnership with French, German and Swiss research organizations (INRA, Hepia, University of Kassel).

SCIENTIFIC CONTRIBUTION

Development of a bioassay with garden cress to test the bioactivity of the biodynamic horn manure preparation

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Question

In plant physiology, ecotoxicology and medicinal bioassays are a major instrument to investigate the

bioactivity of low-dosed substances. Nevertheless, bioassays have rarely been employed to test biodynamic preparations. The present study investigated a specific bioassay with garden cress (*Lepidium sativum* L.) to detect the effects of horn manure preparation

(HMP) on hypocotyl and root growth. The goals were to investigate (1) the sensitivity and long-term stability of the bioassay and (2) the influence of the main test factors.

Method

The bioassay consisted of the hydroponic growing of cress seedlings in polyethylene bags with water as cultivation medium. The layout was a randomized complete block design with 20 replicates. The investigated HMP doses were relevant for practical applications.

Results

(1) To test the sensitivity and stability of the bioassay a long-term series was conducted over 18 months, consisting of 76 independent trials. The effect of the HMP treatment on the root growth was significant ($p < 0.05$, Tukey-Kramer-test) in 35.5% of the trials and in the meta-analysis of the series (-2.5%, $p = 0.004$, Tukey-Kramer-test). However, the effects of HMP fluctuated strongly between single trials (from -32.7%, $p < 0.0001$, to +17.7%, $p = 0.005$, compared to control). In a second series with 38 trials a different HMP was investigated with similar results. Comparison of statistical models provided significant evidence ($p < 0.05$, likelihood ratio test) of a growth-stabilizing effect of HMP.

(2) The influence of four test factors was investigated: (i) water volume in the bags, (ii) geotropism disturbance, (iii) exposure to light, and (iv) cultivation medium. The interactions of the HMP dose factor with all investigated test factors were significant. HMP effects on the root length compared to the Control were maximal (i) at water overdoses (up to +4.2%,

$p = 0.0008$, $n = 4$), (ii) at geotropism disturbances (up to +9.5%, $p < 0.0001$, $n = 8$) and (iii) with neon light exposure (up to +11.6%, $p < 0.0001$, $n = 6$). The results indicated a compensatory HMP effect under stressed conditions (water overdose, geotropism disturbance) and a synergetic effect under neon light exposure. Regarding the influence of cultivation medium (iv), screening experiments showed significant ($p < 0.05$, $n = 3$) effects for well water and for three of the 12 investigated mineral waters. In additional long-term series, the HMP efficacy was stable only in well water (+4.9%, $p < 0.0001$, $n = 14$).

Conclusion

We conclude that (1) the bioassay used in the present study was sensitive for detecting the effects of HMP at doses that are relevant for practical applications; (2) these effects are highly dependant of the investigated test factors. The growth-stabilizing mode of action is likely a stimulation of the plant's adaptability to its environment, increasing plant resilience and self-regulating processes. Further research is necessary to improve and standardize the test design.

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SCIENTIFIC CONTRIBUTION

Alternative herbs and materials for BD manures and BD preps for tropical countries like India

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The present investigation focused on alternative herbs and materials such as glass, mud pots and plastic containers for the production of cow horn manure and periodically evaluated their physicochemical properties, biochemical properties and microbiologi-

cal properties. Biodynamic preparations regulate the biological processes and strengthen the life forces on the farm. Five herbs such as yarrow (*Achillea millefolium*), chamomile (*Chamomilla officinalis*), stinging nettle (*Urtica dioica*), oak bark (*Quercus robur*), dandelion (*Taraxacum officinale*) and valerian (*Valeriana officinalis*) used for BD preparation (BD502 – BD507) are grown only in tropical regions and processed for the formulating the herbal preparations.

The study identified of alternative herbs having similar active ingredients, functions and available in the tropical regions will have significant contribution in biodynamic agriculture in India. The locally available weeds having similar medicinal properties were identified as the alternative herbs such *Aerva lanata*, *Tridax procumbens*, *Tragia involucrate* and *Casuarina sp.* and utilized for preparation of BD alternative herbal preparation (BDA502-BDA505). The BD alternative herbal preparations were analyzed for their physicochemical properties, biochemical properties and microbiology properties. Effect of different manure (BDC, Non-BDC, BD500 manures (prepared with alternative source and vessels), BD preparations and chemical fertilizers) on growth of *Lycopersicon esculentus* were investigated and consolidated. The influence BD 500, FYM, chemical fertilizers soil treatments and untreated control studied on yield of ground nut (*Arachis hypogea L.*).

Ten to twelve locally available biodynamic manures such as biodynamic compost (BDC), cow pat pit (CPP), BD500, biodynamic herbal preparations (BD 502 – BD 507) and organic manures such as vermicompost, panchakavya, coir pith compost, and farmyard manure were periodically obtained from certified Preps makers across India. The physicochemical, biochemical properties (protein, total sugar, humic acid, protease, cellulase, invertase and alkaline phsphatase) and

microbiological studies (total bacteria, Azospirillum, Azotobacter, Rhizobium like colonies, Actinimycetes and fungi properties in these manures were evaluated. Prepared biodynamic compost heaps inoculated with biodynamic herbal preparations (BD502-BD507) and studied the compost maturity and status on nutrients. The Non-biodynamic (Non-BDC) and biodynamic compost (BDC, BDCV-II and BDCV-I) was further analyzed for its extracellular enzymes such as cellulase, invertase, protease and alkaline phophatase. Reported a significantly high levels of cellulase activity (398.15, 334.12 and 302.71 µg glucose released from compost g⁻¹ 24h⁻¹) and protease (421.10, 438.30 and 400.0 µg tyrosine released from compost g⁻¹ 2h⁻¹) were recorded at 120th day and 105th day of BDC, BDCV-II and BDCV-I. Significant amount of IAA (196.38 µg 100 g⁻¹) and ABA (99.63 µg 100 g⁻¹), GA (67.93 µg 100 g⁻¹) in 150th day and zeatin (66.86 µg 100 g⁻¹) in days 120th day were recorded in the BDC. Prepared Cow horn manure (BD500) with lactating cow horn, filled with cow dung in the horn, buried under soil for 4 month and periodically evaluated its physicochemical, biochemical and microbiological properties. The cow horn manure contained highest amount of nitrogen (2.08, 2.12 and 2.17 %), recorded on 90th 105th and 120th day, whereas the phosphorus (0.64 %) and potassium (0.47 %) contents were high on 90th day.

Conclusion

Based on the above scientific investigation on e can utilize alternative herbs and materials for the production of biodynamic manures and also observed their efficacy on growth of selected plants. Moreover, the final products obtained from the alternative Preps such as mud horn manures and BD preps were evaluated for its properties and also its efficacy”

Biodynamic agricultural practices on improving the soil health and the productivity of rice (*Oryza sativa L*) under two agroclimatic zones of Tamil Nadu

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Research question

The biodynamic farming method is being practiced mainly for crops like tea, coffee, mango and some vegetables by large scale farms in India. However, the biodynamic agriculture practices are still not practiced by small scale resource poor farmers in India. In cultivation of rice under biodynamic agriculture package of practices is a prime important for the country. Hence, the present study has been focused on cultivation and assessment in rice under 3 different farming systems such as organic, biodynamic and conventional in 2 different agro-climatic zones of Tamil Nadu, India.

The first part of the study dealt with collection and analysis of existing organic and biodynamic manures. The production of two different manures such as cow horn manure (BD 500) and cow horn silica (BD 501) were utilized and formulated as package for rice cultivation. The raw materials ingredients and the harvested matured manures (BD 500 and BD 501) were periodically analysed for their physio-chemical and microbial properties. Second part of the study focused on isolation and screening of silica solubilizing bacteria from BD manures and studied the bio-pesticidal & antimicrobial properties and microbial diversity of cow horn silica manure. Third part of the study dealt with the dosage optimization of both BD 500 and BD 501 manures for rice cultivation under field condition by following factorial randomized block design. Final part of the study focused to evaluate the efficacy of biodynamic practices on growth, productivity and quality of rice crop and was also compared with other organic and chemical method of practices.

Research Methodology

The experimental work has been accomplished care-

fully and the methodology reported clearly on collection of commercially available organic and biodynamic manures and characterized its physico-chemical and microbial properties. She has also produced cow horn manure (BD 500) and cow horn silica (BD 501) and characterized its physico-chemical and microbial properties at various time scales. She has further formulated cow horn manure (BD 500) and cow horn silica (BD 501) as field sprays and assessed the microbial diversity of BD 500 and BD 501 through metagenomic analysis. The effect of different concentrations of cow horn manure and cow horn silica manure in rice crop cultivated under field conditions were also evaluated by her. The influence of biodynamic agriculture practices on the productivity of rice cultivated under 2 agro-climatic zones of Tamil Nadu were conducted and evaluated the nutritive, physical, milling and cooking properties of rice grains collected from different farming practices. Throughout the studies triplicate were maintained for each experiment. The data in the experiments were analyzed statistically using SPSS software package. The results of these studies are consolidated and discussed with appropriate literature in the present study.

Through the present study the authors have collected 14 different commercially available organic and biodynamic manures and determined its physico-chemical and microbiological properties. The time scale studies on production and characterization of cow horn manure (BD 500) and cow horn silica (BD 501) manure revealed that the BD manures were rich in microbial diversity, primary, secondary and micronutrients. Based on the properties, BD 500 and BD 501 were harvested on day 90 and 120 respectively. The cow horn silica exhibited pesticidal activity. Microbial diversity of both manure such as BD 500 and BD 501 were determined through metagenomic and next generation sequencing analysis techniques.

The influence of biodynamic manures on the productivity and quality of rice was assessed under 2 different agro-climatic zones of Tamil Nadu. The

experiments were conducted at 2 organic farming practicing farmers' fields in Ariyanoor Kancheepuram District (North-eastern zone) and Kadavur, Karur District (South zone) of Tamil Nadu, India respectively, using the optimized dosage of BD500 and BD501.

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SCIENTIFIC CONTRIBUTION

Soil carbon sequestration in selected orchards and agroforests managed through organic, biodynamic and conventional agricultural practices

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The present investigation has been taken up to study the carbon sequestration in existing orchards and agroforests managed by organic, bio-dynamic and conventional agricultural practices. The study further focused on the soil organic carbon sequestration as influenced by different agronomic practices and seasons in two different agro-climatic zones. Based on the study the highest total organic carbon (TOC) was recorded in soil maintained under organic (0.6 to 1.5 %) than conventional orchards (0.47 to 0.76 %) in southern zone. Similarly, in high altitude zone the highest organic carbon was recorded in orchards maintained under organic practices (4.03 to 5.39 %) than conventional orchard system (3.21 to 4.26 %). In case of different seasons, the highest carbon recorded in winter (January-2014) compared to summer (May-2014) and monsoon (September-2014). In southern zone, the highest standing biomass, carbon and equivalent CO₂ was recorded in organically managed orchard (378.46 t ha⁻¹, 189.23 t ha⁻¹, 694.48 t ha⁻¹ respectively). Similar results were also observed in orchards of high altitude zone (TSB-150.09 t ha⁻¹, TSC-51.03 t ha⁻¹ and equivalent CO₂ -187.29 t ha⁻¹). Bacterial diversity in soils of Pear orchards with different ag-

ronomical practices were analysed by culture independent methods. The high-throughput sequencing technology was employed in this study for the analysis of variations in soil bacterial diversity of three soil samples maintained under Biodynamic (sample 1), Conventional (sample 2) and Organic (sample 3) agronomic practices. The results revealed that the phyla such as Proteobacteria (50.9 %), Acidobacteria (18.6 %) and Verrucomicrobia (8.7 %) are commonly distributed but the relative abundance is different among three soil samples. The highest diversity was observed in sample 1 and 3 (13194, 10857) compared to sample 2 (12235) through alpha diversity analysis. The diversity of sample 2 was slightly different from sample 1 and sample 3 whereas sample 1 and 3 was overlapped to each other which indicates its diversity are similar through beta diversity analysis. Further the relative abundance of bacterial species was also analysed deeply in this paper. The soil samples were collected periodically for upto 3 years. The organic carbon in soil from each treatment at different intervals and depth were collected and analyzed. The soil samples collected during January-2014 and 2015 were recorded high carbon content than the soil samples collected during May-14 and September-2014. In all the seasons among eight treatments, the highest carbon content was recorded in intercropping plots compared to non-intercropping plots. The highest organic carbon was also recorded in Organic and Bio-

dynamic practices along with inter cropping in all the seasons. Based on this study, the organic carbon content was recorded high in organic and biodynamically managed plots and also observed adequate nutrients except some of the micro nutrients such as Fe, Mn and Zn. Triplicates were maintained for each experiment of the current research work. Data were analyzed statistically using SPSS package and presented.

Conclusion

Based on these studies, the carbon content was gradually increased from 5 to 20 years of all the orchards and agroforests system. The organic orchards found to have highest organic carbon than conventional orchards in both south and hilly zone. In case of different zones, the hilly zone recorded high organic carbon content than in the south zone orchards. The highest CA enzyme producers are *P. aeruginosa*, *C. freundii* and *P. fragi* among seven bacterial cultures tested for CA production and the quantification of esterase activity and the bacterial growth in the LB broth were

positively correlated with each other.

Literature

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SCIENTIFIC CONTRIBUTION

Integrating biodynamic methods into elm mistletoe cultivation – effects on pharmaceutical products

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Research Question

Elm mistletoe has been used as cancer remedy since 1952, after mistletoe-bearing elms had been found in France (Leroi 1952). A specific therapeutic potential for elm mistletoe extracts (Isador Ulmi) has been observed for the treatment of bronchial carcinoma (Wilkens & Mandera 2012). In order to meet rising pharmaceutical demands on a long-term basis, the cultivation of elm mistletoe was initiated in 1976, based on vegetative propagation of mistletoe receptive elms, based on vegetative propagation of mistletoe receptive elms by root cuttings (Grazi 1987).

During the same period, Dutch elm disease (DED) began to affect elm trees all over Europe (Nierhaus-Wunderwald & Engesser 2003). At the end of the 20th century, known natural elm mistletoe had been almost completely eradicated. First effects of DED on cultivated mistletoe-bearing elms were observed in 2007, and meanwhile 90% of cultivated elm mistletoe stocks have been damaged. In order to guarantee elm mistletoe supply for remedy production, new strategies were developed: Additionally to intensified care and pro-active protection of surviving mistletoe-bearing elms, the generative propagation of mistletoe-bearing elms was developed.

One instrument to improve the resilience against DED was to apply biodynamic (BD) preparations 500 and 501 on surviving and newly raised mistletoe-bearing elms. Because elm mistletoe meanwhile is exclusively harvested from cultivated sites under controlled

conditions, it was possible to examine influences of BD treatment on pharmaceutical mistletoe products with picture forming methods.

Research Methods

On sites near Dornach (Switzerland), where elm mistletoe has been cultivated since 1980, horn manure spray preparation (BD 500) was applied in March 2011. Selected mistletoe-bearing elms (= type A = frequent BD treatment) received additional BD 500 application in April and May 2011. Horn silica spray preparations (BD 501) were applied on these elms (type A) two weeks before the harvest of summer mistletoe in June and in October, i.e. six weeks before winter mistletoe harvest. In comparison, selected mistletoe-bearing elms of type B (= rare BD treatment) did not receive any BD 501 application and only one BD 500 application in March.

Duplicate samples were taken for type A and type B treatment from a) summer mistletoe extract (SuEx), b) winter mistletoe extract (WiEx) and c) Iscador Ulmi (active substance = SuEx and WiEx blended on a specific device; see Baumgartner et al. 2014). Samples were blinded and examined with capillary dynamolysis, round image chromatography and copper chloride crystallization; differences were described qualitatively.

Results

The 12 encoded samples could be correctly grouped (SuEx, WiEx and Iscador) by means of capillary dynamolysis and round image chromatography. Within the three groups, the samples could be correctly allocated to frequent BD application (type A) and rare BD application (type B).

Copper chloride crystallization generated poorly differentiated images for SuEx and WiEx samples that did not allow differentiation of frequent (A) and rare (B) BD application. In contrast, highly differentiated images for Iscador samples allowed to identify differences between frequent (A) and rare (B) BD application. These were comparable to differences found between hand mixture of summer and winter mistletoe sap versus blending of summer and winter mistletoe saps on the Iscador-specific device.

Conclusions

Frequent BD application on mistletoe stocks seems to enrich the inner quality of the active substance (Iscador) in similar ways as blending summer and winter mistletoe saps on the Iscador-specific device. Synergistic effects can be hypothesized.

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SCIENTIFIC CONTRIBUTION

Biodynamic preparations on static pile composting from *Opuntia ficus-indica* and *Moringa oleifera* wastes

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Static pile composting has advantages over traditional techniques, such as reduction of energy and costs, because of the turning reduction. The efficient composting techniques associated with the biodynamic preparations (BP) (as the fundamental basis of biodynamic agriculture) develop the sustainable agriculture and conscious care of the environment. In the present investigation *Opuntia ficus-indica* (prickly pear) and *Moringa oleifera* (Moringa) were used as main substrates for static pile composting. The experiment was carried out under a completely randomized factorial design. Four treatments were evaluated, combining main substrates and BP inclusion: T1 (Prickly pear+BP), T2 (Moringa+BP), T3 (Prickly pear) and T4 (Moringa). Compost piles were constructed according to C:N ratio 20:1 and moisture 60%. Passive aeration was promoted by PVC pipes horizontally placed at the bottom of the piles and holed each 10 cm. Pile dimensions for all treatments were 1.3, 0.85 and 2.5 m of width, height, and length, respectively. Moringa and prickly pear wastes were chopped up to obtain 5-10 cm (used in the bottom layer in order to increase aeration) and lower than 5 cm pieces (used in the middle and top layer to promote decomposition and mineralization). The BP were added in a proportion of 2 g of each solid preparation (502-506) and 5 mL of the liquid one (507) for each pile. The values of physical, chemical and biological parameters that were measured through the time (temperature, pH, EC, moisture percentage, OM, TOC and microorganisms) were analyzed by the selection of nonlinear regression models with criteria of the highest determination coefficient (R²). The data obtained of each variable (total of 16) in the different sampling points were subjected to an analysis of variance (ANOVA). A principal components analysis was performed to relate variables with treatments. Mean comparison was performed using orthogonal contrasts and Tukey honestly significant difference test ($p < 0.05$). Data were analyzed during the active period (100 days), based on the microorganism activity and temperature stabilization.

The temperature during the first 5 days showed a maximum increase of 58°C. The temperature of the bottom layer in all treatments was significantly lower than the upper layers during the first 40-50 days. It showed the efficiency of the aeration method (passive) to promote the bacteria and yeast/mold growth, reaching maximum values about 1.69×10^8

and 6.77×10^9 UFC, respectively. Moreover, it showed not to be necessary the turnings to aerate the system. The temperatures obtained in each pile showed optimal values as human pathogenic bacteria controlling. Different investigations demonstrated that at 50°C *E. coli* and *Salmonella enteritidis* were inactivated, although it not only depends on temperature, but on the moisture level and nature of the material.

For those variables measured through the 100 days period, quadratic and cubic regression models were adjusted to data.

The significant interactions of the evaluated factors (BP inclusion and principal substrate) showed in general, higher temperature and mineralization in compost with BP and prickly pear. In case of the main factor -BP-, significant difference was found for the variables bacteria and C:N, where the treatments including BP showed the maximum values. For the main factor -substrate-, significant difference was found for MO, C:N and hydrogen, where prickly pear treatments showed the maximum values. For the case of Mg and yeast/mold no significant statistical difference was found.

Through a principal component analysis, the first component (61.77%) showed a correlation between bacteria, temperature and C:N, associated with T1, in addition to the correlation between N, P, K, Ca, Cu, Zn, Fe, and Mn, associated with T4. The second component (27.01%) showed a correlation between yeast/mold, OM, Mg and humidity, associated with T3.

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SCIENTIFIC CONTRIBUTION

Application of foxglove-extract in combination with different potassium fertilizers

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In the early period of biodynamic agriculture the application of foxglove extract (*Digitalis purpurea*) in combination with potash magnesium fertilizer was a common practice. This was recommended by Rudolf Steiner in before he held the 'agricultural course'(1924). The extract of this strong medicinal and poisonous plant should bring life to the mineral fertilizers. In the search for sustainable strategies of fertilization and quality assurance in biodynamic plant production a long term fertilization trial was conducted between 1997 and 2009. The trial a site had a known potassium deficiency and was located on the farm 'Dottenfelderhof' in Hessen, Germany with a 12 year crop-rotation. The goal was to determine the fertilizing effect of potassium magnesium in comparison to rock dust and to examine the effect of additional foxglove-extract.

The trial had a two factorial split-plot design with fertilization as first factor: 1. control without treatment, 2. potassium magnesium, 3. orthoclase, 4. basalt dust; and the treatment with or without foxglove extract as second factor. Fertilizer was applied within the crop rotation only to root crops and to Alfalfa or grass-clover ley at 400 kg K/ha. The treatments with foxglove-extract (10%) were applied with the fertilization (200 l/ha, 6.5%) or in combination with the bio-dynamic spray-preparations 500 and 501 (150-200 l/ha, 0.1%).

The results show that in fertilization variants only the potassium magnesium showed a high efficiency. Rock dusts were mainly ineffective. The measured nutrient extraction verified the effectiveness of potash magnesium application in the case of potassium

deficiency.

During the trial period the application of foxglove-extract resulted in a significant increase of yield (4%-6%) in case of cereal straw and field forage (vegetative growth) in seven of nine years. All investigated elements had higher uptake rates when foxglove-extract was used. Also quality parameters e.g. development and stability of vitamin C was significantly improved (13%). Additional effects of foxglove are a normalising effect that is also known from other biodynamic preparations. In case of oats an interesting interdependency between fertilizer and foxglove was observed: low emergence rates were increased and high rates were reduced.

As conclusion it could be shown that foxglove-extract improved the nutrient uptake of plants and the metabolic processes in the plant and between plant and soil. Because of its high medicinal effect foxglove-extract can support the other biodynamic preparations. Concerning fertilization treatments the results confirmed the high importance of potassium application for yield, nutrient uptake and plant health in case of potassium deficiency.

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Study on the Effect of Biodynamic Farming on Improving the Yield and the Quality of Green Agriculture Crops

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Green agriculture, which has strict limitation for utilization of chemical fertilizer and pesticide, becomes popular in the past decade. It is an important step in agriculture development to encourage the application of organic fertilizer and reduce the chemical fertilizer use in China. However, green planting achieved limited effect on soil activity development and structure reestablish, because of improper use of organic fertilizer, inadequate soil conservation, and excessive pursuit of yield capacity. In contrast, field experiments were carried out with biodynamic farming to improve soil activity and increase the productivity of green agriculture crops. Three economic crops, three fruits, and two planting methods were selected in this study.

Three kinds of economic crops were cucumber, eggplant, potato. And three kinds of fruits were apple, cherry, grape. The cucumber, eggplant, potato and one group of grape were planted in greenhouse; and the apple, cherry and another group of grape were open-planted. CPP, 500, 501 were prepared followed Demeter method. The application method of the preparations was designed as follows: the first time

to apply CPP+500 was around germination stage; the second time to apply CPP was two weeks before the flowering period of the crops or the fruiting period of the fruit tree; the third time to apply CPP+501 was on fruit maturity stage. Cucumber was treated with CPP every three week during the fruiting period. The specific CPP, 500 and 501 application was following the biodynamic sowing and planting calendar.

Experimental data confirmed that the biodynamic farming has a significant effect to enhance the crops and trees growth. The average yield improvement of cucumber, eggplant, potato, apple, cherry, grape were 38.32%, 22.41%, 17.22%, 16.09%, 24.41%, and 16.66% separately. Sugar content enhancement of apple, cherry, grape were 33.31%, 11.02%, and 14.73%. The pest and disease threat was under great control also in these experiment. Meanwhile, cucumber experiment confirmed that the sustainable effect of CPP treatment was around 25 days. CPP has significant antagonism with industrial humic acid, fulvic acid and auxin. And this antagonism varies according to the crop. Therefore, it is necessary to strictly control the mixed use of biodynamic technology and plant hormones to prevent production reduction due to antagonism.

Keywords: Biodynamic, CPP, Yield Improvement, Sustainable Agriculture, Green Agriculture.

Assessment of the contribution of microbial activities to tomato growth and yield under an organic production system

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Crop production is dependent on microorganisms for maximizing productivity. This is largely because soil

microorganisms perform important functions such as nitrogen fixation, organic matter decomposition, nutrient mineralization and solubilization, exploration, absorption and transfer of nutrients to plants, formation of humus, and improvement of soil structure.

Indeed, microorganisms are central to a healthy soil, and functions needed for maximum crop productivity (Dick et al., 2001). More so, in organic cropping systems, microbially mediated decomposition and nutrient mineralization are central functions in the crop management. Indeed, the systems rely on sound management of soil organic matter to enhance the chemical, biological and physical properties of soil (Watson et al., 2002). Utilization of compost as a soil fertility sustenance strategy has been widely accepted as a sound practice in crop production systems (Rynk 1992, He et al., 1995). The optimization of microbiological activities in organic and conventional crop production systems is crucial to the realization of optimum productivity of the soil. Field and pot experiments were conducted to assess soil microbial activities, growth and yield of tomato varieties in response to 4 rates of composted plant and animal residues. The compost rates were 0, 5, 10 and 20 t ha⁻¹, and improved Ibadan and Ibadan local constituted the varieties. Fungi population, microbial biomass nitrogen, cellulase and proteinase activities were significantly higher ($P \leq 0.05$) at the rhizosphere of the local variety than that of improved variety. This led to significantly higher number of branches, plant height, leaf area, number of fruits and less days to maturity in the local variety. Furthermore, compost amended soil had significantly higher microbial populations, microbial biomass N, P and C, enzyme activities, soil N, P and or-

ganic carbon than control, but amendment of 20 t ha⁻¹ gave significantly higher values than other compost rates. Consequently, growth parameters and plant N concentration significantly increased in all compost treatments while dry matter yield and weight of fruits were significantly higher in soil amended with 20 t ha⁻¹. Correlation analysis revealed that microbial activities at 6 weeks after transplanting (6 WAT) were more consistently and highly correlated with growth and yield parameters. It was concluded that microbial activities could be optimized to improve the yield of the two tomato varieties in through the application of compost, particularly at 20 t ha⁻¹.

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POSTER SESSION

OBSERVATION REPORT

Effects of use of biodynamic preparations on rainfall

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Daily rainfall measurements are taken at our farm since February of 2014. We also record the dates of use of preparations 500 and 501 and barrel compost, the last being made according to Peter Procter's instructions in *Grasp The Nettle*. Previous experience indicated that a significant rainfall, defined as .15 inches (approx. 4 mm) in a single 24-hour period, occurred more frequently with prep use within 5 days of prep use. We compared rainfall within 3, 4, and 5 day

windows after prep use with the set of all possible measurements of the same length where preps were not used for the time period March 2015 to January 2018. We had 45 observations with prep use. For 3 days, we had significant rainfall 49% of the time versus 44% without preps; 4 days 59% vs 52%; 5 days 69% vs 58%. Additionally, average rainfall for the 3, 4, and 5-day periods was compared to the average rainfall for 5-day period preceding the use of preps, although this is not truly part of our research question. Rain increased by .016 for 3 day, .018 for 4 day, and decreased by .004 inches for 5-day period. Additionally,

since we have been using preps extensively during the period in question, we have seen an increase in annual rainfall (our "rainfall year" is February 19 thru February 18, as we started measurements on February 19 2014) from 26 inches in 2014 to 37 inches in 2015, 38 inches in 2016, 44 inches in 2017, and for the first 5 weeks of 2018 we have 13.6 inches, 50% above the highest prior year to date.

While statistical tests could theoretically be applied,

our position is that this is a census of rainfall data rather than a sampling, and we are in no way suggesting our farm is representative of a larger population and besides would be a sample of 1 farm, so that a statistical test is not appropriate for the data. As such we submit this as an observation poster.

References

Peter Procter, Grasp the Nettle

POSTER SESSION

OBSERVATION REPORT

Quality of Horn Silica preparation out of different raw material and sheaths making

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Research question

Are there differences of quality in Horn Silica Preparation when using different raw material and sheaths? How far can we appreciate those differences claimed in the biodynamic literature by easy made tests?

Research method(s)

The paper circular chromatography test developed by Pfeiffer (1984) (see also Restrepo & Pinheiro, 2011) was used with a total of eight different ways of making the horn silica preparation they were buried between Spring and Autumn 2013 in Las Encabras Farm (Pozocañada, Albacete): 1.- quartz flour sheathed by common cane (*Arundo donax*); 2.- quartz flour within a glass pot; 3.- quartz flour within a plastic bag; 4.- milled industrial glass flour sheathed by a cow horn; 5.- quartz flour as control (no sheathed not buried), 6.- quartz flour within a clay pot; 7.- milled industrial glass flour as control (no sheath not buried); and 8.- quartz flour sheathed in cow horn (501).

The different combinations were chosen out of the interest of the Con Respeto's farmer learning community members involved and the stress was focused mainly in whether that quite well-known test within biodynamic literature could fit in our interest to see a clear answer on this particular subject. No replicates were carried out with the samples of each of the eight variants tested. A simple box with control of temperature and humidity was used. The testers made the cromas with blind samples in a first analysis.

Results

By looking for extreme differences in pictures, sample 8 (501) and 7 (glass flour control) showed the more striking ones. A rather radiant and harmonic picture with violet needles connecting from the centre to the outer borders was shown up in number 8 versus a very amorphous darker violet grey colour with concentric rings picture with no radiant needles at all in number 7. Among those extremes, in a decreasing gradient from the number 8 sample to the 7, we found sample 1 (quartz sheathed by Cane) > 4 (glass flour sheathed by cow horn) > 5 (quartz control) > 3 (quartz sheathed by plastic) > 2 (quartz in glass pot) > 6 (quartz in a clay pot).

Conclusion

The paper circular chromatography developed by Pfeiffer seems to be good enough to appreciate

visually differences of quality between horn silica preparations using different raw material (quartz and flour glass) and different sheaths. Showing up that cow horn seems to be the best one among the several used in this test. Outstanding differences were found when using cow horn as sheath in comparison with control samples based in both quartz and glass flour what points out the key role played by the sheaths proposed by Steiner in the proper making of biodynamic preparations. Some training on reading those kinds of pictures is necessary to understand the lan-

guage of the images coming out, but methodology is quite simple and the concentration in the reading is good for training in all sort of morphological languages in plants, animals and landscapes to be deal by farmers as well as by other actors interested in landscape use and management.

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POSTER SESSION

OBSERVATION REPORT

Essay of elaboration and application of biodynamic compost with addition of clay and basalt

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The use of biodynamic compost has demonstrated its efficiency in terms of biodiversity, soil fertility, yield and quality of production, as well as in energy input (Mäder et al., 2002). In this trial, we tested if it could even be improved with the addition of other inorganic components, in a small proportion, such as clay and basalt (Florin, 2006; De Almeida et al., 2007).

A trial was established at the Las Encebras farm (Pozocañada, Albacete, Spain) to evaluate the benefits of the addition of basalt and clay in different doses (2, 4, and 10%) during the production of biodynamic compost with cow manure and the 502 to 506 preparations. Six piles were established that corresponded to the 6 treatments tested, including a control. The compost analyzes shown that the addition of clay in higher doses, as well as the combination with basalt, generates a more mature compost, with greater cation exchange capacity and higher content of phosphorus and potassium.

Once the compost was elaborated, it was applied

differentially in a double plot that had had two precedents, beans and sunflower, and on which a Khorasan variety wheat crop (*Triticum turgidum L. ssp Turanicum (Jakubz.)*) was established. In the test field, 36 elementary plots were marked, corresponding to 2 precedents * 6 treatments * 3 repetitions of each of them. The effect of the diverse types of compost was evaluated in the wheat harvest, assessing yield and yield components. Some conclusions after ANOVA analysis are: Compost with basalt produces higher biomass and higher yield (both by number of grains and by weight of grains). The compost with basalt and clay, which contained more phosphorus and potassium, produces a greater proportion of grain compared to the total. (Few spikes, little straw and normal grain). Compost with 4% clay presents the worst grain yield.

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Biodynamic preparations, greater root growth and health, compensation for stress, and soil organic matter increases are linked

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Research question

Long term research trials in Germany, and Switzerland showed that use of biodynamic preparations can have a beneficial effect on soil organic matter and soil biological activity. A review of several European trials led some authors (Raupp and Koenig, 1996) to suggest that preparations can lead to compensatory plant growth and yield under sub-optimal conditions. Laboratory and field studies by the author in Europe and the USA suggest that biodynamic preparations can stimulate root growth. Are the effects of biodynamic preparations on soil organic matter and yield for real and if so, do they have to do with greater root production and root health?

Research method

This poster reports on experiments to determine the effects of biodynamic preparations. A bioassay with wheat seedlings tested effects of biodynamic preparations on wheat seedlings (Goldstein and Koepf, 1982). Research tested effects of biodynamic preparations in the context of different crop rotations in Washington State, USA (Goldstein, 1986). Research was carried out to develop and test a new formula for a compound preparation in Wisconsin, USA and this included laboratory and field trials (Goldstein and Barber, 2005) This research compared various formulations of compound preparations (Pfeiffer starter, Thun Barrel Compost, Super-500, and the new nettle-and-manure-based compound preparation).

Results

The bioassay with wheat seedlings showed stimulatory effects of herbal preparations on root growth (Goldstein and Koepf, 1982). Research in Washington State showed increases in root growth of winter wheat, microbial biomass, and soil organic matter associated with the use of preparations (Goldstein,

1986). Research on the nettle compound preparation showed that it increased root growth of maize and root health, increased particulate organic matter, and also exercised positive yield compensatory effects for maize and wheat (Goldstein and Barber, 2005) under stress condition years.

A review of the scientific literature suggests that particulate organic matter often forms around roots and thereby stabilizes organic matter in intermediate turnover pools.

Conclusion

Our studies confirmed that biodynamic preparations can stimulate root growth and cause positive yield compensation under stress conditions. Positive effects of preparations on root growth were shown by our above-mentioned trials and in the long-term Darmstadt experiment (Bachinger, 1996). The extra root growth that can be associated with the use of certain preparations is hypothesized to increase soil organic matter by increasing the pool of particulate organic matter. The greater root production and root health that can be associated with the use of certain preparations is hypothesized to cause better growth and greater yield under stress conditions.

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POSTER SESSION
SCIENTIFIC CONTRIBUTION

***Equisetum arvense*, P 508, plant protection activity from the lab to the field**

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Overview

Horsetail, *Equisetum arvense* L. has long been known in botanical folklore as having a preventive effect on fungal plant diseases. The traditional hot water extract from *E. arvense* has long been used by organic and biodynamic farmers (Marchand, 2017). *E. arvense* water extract is intended to be used as plant strengthener and preventive treatment of pathogenic fungi. In this way, we are presenting some papers about the effect of the natural silica (silicic acid) used for the control of powdery mildews and fungal diseases in some cultures. *E. arvense* extract is a foliar stimulator of natural defences and fungicide for use as a spring post-emergence treatment in all cultivars of grapevine and apple trees. In literature, the described mode of action would be based on the high percentage of silica in the plant that works on lowering the impact of moisture. Silicon would reduce the effects of excessive water around plants that would lead to fungus. It would act also as an activator of plant defence mechanisms. Silicon (Si) is a bioactive element associated with beneficial effects on mechanical and physiological properties of plants. Silicon alleviates abiotic and biotic stresses and increases the resistance of plants to pathogenic fungi. *E. arvense* extract was also shown to possess a broad spectrum of a very strong antimicrobial activity against all tested strains. The radical scavenging activity of extracts significantly correlated with total phenolic content. The antimicrobial tests showed that ethyl

acetate and n-butanol extracts inhibited the growth of tested bacteria.

Plant extracts recipe

The decoction is processed as follows: 200 g of the aerial part of *E. arvense* dry plant tissues are macerated in 10 l of water for 30 min (soaking) and then boiled for 45 min (Marchand, 2016). After cooling down, the decoction is filtrated with a fine sieve or more generally with a stocking and then further diluted by 10 with water. The solvent for extraction and preparation was water (spring water or rainwater) and the pH was 6.5. Decoction is described in the implementing regulation (EU, 2014) and a further "Report Review" is available in EU pesticide database (Marchand, 2015).

Agriculture Uses as plant protection means

Field typical suitable concentration is 200 g of active ingredient (a.i.) hl⁻¹. The aqueous extract of horsetail as decoction is intended to be used in fields for plant protection on grapevines (Darnand, 2016) and apple trees and vegetable gardening to control diseases such as mildew, downy mildew and others caused by foliar fungi such as *Pythium* and *Alternaria* spp. Horsetail has long been known in the botanical tradition, organic and biodynamic agriculture as having a preventive effect on fungal diseases of plants. The effect is based on the high percentage of silica in the plant, which helps to reduce the impact of moisture. Silica would reduce the effects of excess water on plants that lead to the growth of fungi. *E. arvense* decoction shows anti sporulation activity (Marchand, 2016). It would also be an activator of the defence mechanisms of these plants.

Mode of action

Efficiency of P508 preparation is often tested in different trials, in vitro, in vivo and in campo. In vitro, we

established that efficacy may be due to anti-sporulant properties of the extract as germination of mildew spores of may be temporarily stopped by addition of the *E. arvense* extract (Marchand, 2016). In vivo, treated foliar discs show protection from inoculation. In fields (in campo), potential efficiency of P508 is measured by the delay of mildew re-infestation in vineyards (Darnand, 2016).

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POSTER SESSION

OBSERVATION REPORT

Perfecting a new biodynamic stirring machine: Cosmophore

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Wine producers interested in biodynamics are numerous and looking for an equipment which is convenient, unexpensive, easy to use and to keep in repair. They don't have manual stirring in view, at least in a first step.

In 2012, we put the idea in form, based on a mechanical stirring in an egg-shaped container, inspired from Viktor Schauberger's diagram.

After the first experimental device, different materials were tested. We selected copper (the most used), stainless steel, food plastic, and glass fibre. We started stirring osmosed water alone for an hour, then we stirred horn manure in water coming out of the osmoser.

A prototype was made in 2013 on the basis of:

- a 400 effective litres tank,
- a mechanical direct-drive motor-reducing system,
- a triple blade (peripheral stirring and parabolic vortex),

- a temporizing reversing with power relay and inversion delay, which has the advantage not to depend on the filling-level of the tank.

A first test was done at Marc Guillemot's, when we compared the glass fibre stirring machine with the model Ecodyn present on the estate. Both stirring machines were filled with the same volume of rain water; the water was pumped and stirred alone, then it was re-pumped to be stirred with horn manure.

Experiments in the field

From 2014 to 2016, we made a test on a vine never treated in biodynamics:

- a new Guillemot parcel where we compared both stirring machines (same applications of spray preparations)
- 2 parcels in organic culture at Nicolas Maillet's, where we compared the passage of spray preparations stirred with the Cosmophore to a not biodynamic sprayed trial.

Since 2016, a new test has been done with the help of François Duvivier, from the Marquis d'Angerville's estate at Volnay, in 2 never biodynamics applied parcels (one black Pinot, one Chardonnay), each time with

untreated check, Ecodyn and Cosmophore modality.

Since 2017, a simplified trial has been settled on temporary meadow at Loïc Villemin's in the Vosges, where we compared the application of spray preparations stirred with Cosmophore with one without biodynamics.

The modalities were tested with the sensitive crystallizations of Margarethe Chapelle but also with the perceiving method of formative forces according to Dorian Schmidt by Christine Sutter, then by Christelle Verhaege.

With regard to the Volnay trial, the parcels were also visited at random by vine growers and MABD animators.

Improving resin by incorporating homeopathy

Even if experimentation proved that the resin-fibre material was neutral (glazing during polymerization), it doesn't have the qualities of something natural. After having heard José Martínez's paper on the Pneumatit method, which consists in using homeopathy with concrete, we tested incorporating it in resin when we made the tank.

Several formulas were tested in the shape of triturations in D6 and the best results were obtained with the blend of limestone, clay, silica, silver, mercury, copper, gold, iron, tin, lead; it gathers the earthly substances having the most powerful impact on plant life and metals associated with solar system planets.

The first Cosmophore stirring machines incorporating homeopathy were made at the end of 2017 and will be followed-up in 2018.

Results and prospects

The various experiments show that several types of stirring machines can give good results. The evaluation of the quality of the dynamization at the outgoing of the tank is quite predicting of its efficiency on the plant. The sensitive crystallization method is rather discriminating, but the direct approach in the field of the subtle forces allows a better differentiation of the dynamizations.

Incorporating homeopathy in resin changes completely the energy surroundings of the tank. We will start a comparative experiment with manual stirring in 2018.

POSTER SESSION
SCIENTIFIC CONTRIBUTION

Influence of biodynamic yarrow preparation on radish under different fertilization levels of potash magnesium

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The improvement of potassium availability of arable crops under long-time biodynamic cultivation on potassium deficient, potassium fixing soils has been an important research question on the Dottenfelderhof, Bad Vilbel, Germany. According to Rudolf Steiner a biodynamic preparation from the flowers of common yarrow (*Achillea millefolium*) should support the potassium absorption of the plant. In this trial, the aim was to examine the impacts of yarrow preparation, by developing a potted trial and analysing the effects on development, yield and nutrient content of radish plants under different levels of potassium

availability in the soil.

Therefore, blind trials were conducted over a period of 3 years (1998-2000) in a partly randomized two-way factorial design of Kick/Brauckmann plant culture pots (8L) with four to five replications.

The first factor was the fertilization with mineral potash magnesium for which increasing amounts of potash magnesium (30% potassium sulphate, 10% magnesium sulphate) were added to a soil mixture of 30% arable soil (sU, Dottenfelderhof) and 70% washed-out sand. The second factor was the soil treatment with and without yarrow preparation. Therefore, half of the culture pots of each level of potash fertilization received 1g of yarrow preparation per pot, while the

other half of the pots stayed untreated. The preparation was added to the soil at 10 cm depth in the middle of the pot one week before sowing the radish. Further, the soil of all pots was treated with horn meal and monomagnesium phosphate. But as the plants showed symptoms of nitrogen deficiency under this treatment, the basic fertilization was doubled to 1g N and 0.8g P per pot.

For the trial, 80 seeds of the radish variety "Sora" were sown to each culture pot. The plants were isolated to 20 plants in 1998, and to 19 plants in 1999/2000 and harvested 6 weeks after sowing. The radish plants were analysed on their dynamic of development, symptoms of potassium deficiency, water usage and leaf surface area, as well as yield. Furthermore, the concentrations of K, Na, Mg, P and N were determined for bulbs and foliage of the radishes. According to the results yarrow preparation showed significant effects in the culture pot trials. One effect was the withdrawal of potassium, as well as increased K:Mg and K:N ratio and also the leaves showed less distinct symptoms of potassium deficiency. Another significant effect was an increased water use efficiency and germination rate, as well as length and size of the cotyledon and leaf size. Furthermore, different forms of yield gain were observed in bulb and/or foliage, as well as changes in the bulb:foliage ratio.

In conclusion the trial showed impacts of the yarrow preparation on the growth of the radishes, as well as interactions between the yarrow-treatment and the potash magnesium fertilization. According to the growth conditions, the yarrow preparation indicated partly stimulating, partly regulating impacts on the potassium appropriation as well as on the potassium dependent processes of plant growth. As expected, these processes were influenced by the potash magnesium fertilization, but also by the yarrow preparation. The effects of the yarrow preparation seemed to be "usefully modified" corresponding to the given growth conditions of the radish plants. The results indicated an influence of the biodynamic yarrow preparation on the regulatory system of the plant physiology.

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POSTER SESSION OBSERVATION REPORT

This is Really a Good Sign! The Earthworm Story

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Young Raphael knelt in the freshly turned soil. A guinea grass root wad filled his lap. As he raked the soil away from the roots with his fingers, he started counting the earthworms.

Nearby brother Olie was knocking the soil off another root wad with a shovel. The earthworm count got to five and Olie took notice, "This is really a good sign!" Then Olie got my attention, "Marie, Raphael is counting earthworms. He's up to eight. THIS is really

a good sign."

The count continued and Olie got more excited with each wiggling sign of life. When the earthworm count got to twenty-two, Olie had loudly exclaimed seven times, "This is REALLY a good sign!"

The children spontaneously counting earthworms was a peak moment on the farm Twelve years ago, the soils at Spirit of the Earth Farm were polluted with pesticide residues from DDT. There was a pervasive hard pan and not an earthworm in sight.

The area of the earthworm count had not been culti-

vated before. What caused this wonderful transformation of the soils?

The nine biodynamic preparations have been applied to most of the 16 ½ acres of the farm several times a year. Those who come to the farm to help are asked to put love into everything they see and touch in their own way, to the best of their ability. Our "lead" Kukui tree has been transmitting the biodynamic preparations "radionically" for many years. Gold, frankincense, and myrrh have been applied in January for seven years as an invitation to the nature spirits to feel welcome on the farm. While tending the gardens, golden rays are invoked to stream through the soil from Christ's mystical sun globe in the interior of the earth. A portal to communicate with the angelic realms has been integrated into the Kukui council of trees by burying precious gems in the form of a star octahedron.

Whatever caused the change in the soils at Spirit of the Earth Farm, the earthworms are happy. And, this is REALLY a good sign!

Most farmers and gardeners know that the presence of earthworms is a good sign. How earthworms benefit the soil is fascinating. Their life cycle, how they reproduce, move, and regenerate if not damaged too severely are all equally as fascinating.

Earthworms' benefit to the soil starts with a structural design and digestive system extraordinaire. Earthworms are born to burrow. They chew fresh and old roots which form the channels for their burrow, drag

in larger plant material and manure as well as particles of sand, all of which move through a digestive system which includes a gizzard. Their excretions, which are called castings, are humus-rich and contain minerals and nutrients which are readily available to plants. The humus-rich castings also help form aggregates that result in beautiful soil structure. Soil aeration and drainage are both improved by the web of channels earthworms create.

Ehrenfried Pfeiffer's assistant, Marjorie Spock, shared in a letter, "that it took 3 weeks for the bd preps to restore earthworms to his greenhouse soil after he had doused it heavily with DDT. (He tried this as a test.) The presence of earthworms in soil is sweet proof of decontamination, for though DDT kills all but the strongest worms "on impact," those that survive reproduce quickly."

In the mid-west an experiment with crop rotation was done. The old rotation was 1 year soybeans then 1 year corn. The experimental rotation was 1 year soybeans, 1 year corn, 1 year red clover, and 1 year alfalfa hay. The results are note-worthy. The earthworm count went from 18 thousand per acre to 1.3 million per acre! There was 97% pesticide reduction; 90% synthetic fertilizer reduction; and an organic matter increase from 2% to 6.5%.

The more we know about earthworms, their likes and dislikes, the easier it will be to create conditions in our gardens and farms which result in happy earthworms. Build it and they will come. This is an endeavour worth pursuing.

POSTER SESSION
SCIENTIFIC CONTRIBUTION

A better balance in quantity and quality: scope for the use of OP varieties bred for quality and taste

Nuijten Edwin

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Currently, two trends in society are visible. One trend is that conventional breeding increasingly focuses on F1 hybrid breeding and the use of patents. Another trend is that consumers, in particular organic con-

sumers, value product quality more and more. For organic traders and farmers this means an alternative approach in breeding becomes more urgent: a breeding approach that meets economic, societal and nutritional values in a balanced way. The breeding of open pollinated (OP) varieties has the potential to meet these values, important for organic consumers.

However, the choice of good OP varieties in terms of yield, storability and uniformity is often limited as the focus in plant breeding has been on F1 hybrids for the past 40 years. In organic agriculture, good taste and good nutritional values are also considered important traits.

So far, breeding has focused on yield and storability. However, some field trials on carrot and pumpkin suggested there can be a negative relation between storability on the one hand and taste and quality on the other hand. It implies that varieties with good taste are more difficult to store than the commonly used varieties by farmers. An important question is what can be done to improve the storage period of vegetables with good taste and quality. One option may be to look for varieties that have a good balance in storability, taste and nutritional value.

To answer these questions field are conducted for two years with three vegetable crops (pumpkin, red cabbage and carrots) on two bio-dynamic farms with different soils (clay and sand). For each of the crops, three open pollinated varieties are compared with two F1-hybrids. On each of the farms the trials were set up with three replications and completely randomised designs. On both farms, two harvest dates were applied for all three crops. Sowing, planting and harvesting dates on both farms were chosen as similar as possible. Apart from general observations on crop growth, the crop traits that were measured for analysis were yield (fresh and dry matter yield), storability, taste (after harvest, mid storage and after storage), and nutrient quality (dry matter percentage, Brix and content of eight minerals). Tasting was conducted at

the beginning of the storage period, half-way and towards the end of the storage period. ANOVA and correlations were used to analyse the results.

Results based on the first-year show that the interactions for yield, storability, taste and quality are complex and crop specific. Whereas for pumpkin a red cabbage there is a negative relationship between dry matter yield and storability, a positive relationship was observed for carrot. Whereas a positive relationship of taste with, dry matter content and Brix was expected, no clear correlations were found for all three crops, which was expected given the negative relationship between dry matter content and yield.

For each of the crops, no general patterns were observed that were applicable to all crop varieties in terms of change in taste during storage. For pumpkin, varieties grown on sand tasted generally better than from clay soil. For some varieties, however, taste decreased on clay soil during storage, whereas not for other varieties. For carrot and red cabbage, the dynamics in taste development during storage were more complex.

Some general trends were identified and will be tested again this season. In general taste from crops grown on sandy soil remained stable or improved during storage, whereas taste from crops grown on clay soil tended to decrease in taste more easily. However, storability from crops grown on sandy soil tended to be less compared to clay soil. Another important aspect is that whereas fresh yield differed much among varieties, differences in dry matter yield were much smaller. This implies a different perspective on the potential use of OP-varieties bred for quality and taste.

POSTER SESSION
SCIENTIFIC CONTRIBUTION

Improving soil fertility on biodynamic and organic farms with low stocking densities or no animal husbandry?

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The aim of the EIP-AGRI project BRAVÖ in Baden-Württemberg, Germany, is the investigation and evaluation of various innovations to maintain and improve soil fertility that are already in use on biodynamic and organic farms with low stocking densities or no animal husbandry at all.

The project consists of four parts: 1) Evaluation of existing practices ("innovations") to maintain soil fertility initiated by the participating organic farmers (the "inventors") with low stocking densities or no animal husbandry, 2) Field trial on the assessment of clover grass-based fertilizers, 3) On-farm trials for a better understanding of the innovations applied by the inventors and 4) Knowledge transfer between the "inventors" and other interested farmers (test farms). The project includes an intensive networking between the participating farms, farm advisors and academic researchers.

The projects focus on ten farms (six Demeter and four Bioland farms) that have already established an innovation to improve soil fertility, and ten farms that are interested in the adoption of these innovations. Innovations include the use of clover grass-based fertilizers (cut & carry of fresh clover grass biomass, and silage mulching), methods of composting of organic matter from the farm, the combination of new green manures (including the application of fermented plant materials) and modified soil tillage systems. The selected innovations should be highly sustainable. The purchase of organic and nitrogenous fertilizers should

be as limited as possible. The ten "inventors" present their practices for maintaining soil fertility in field days to other interested farmers.

Ten test farms have the possibility to try out one or more of these innovations on their farms from the second year onwards. The test farms will be supported during the introduction of the innovations by advisors and the "inventors". A sustainability analysis of the ten "inventor" farms will be carried out, which includes elements of the life cycle assessment, a humus balance and an economic evaluation. Based on this, recommendations for the development of the farms will be given by the advisors and the researchers. A sustainability analysis in the 3rd year will monitor the success of the farm development.

Field trial: The field trial focuses on clover grass based-fertilizers that can be produced on-farm or on neighbouring farms, resulting in higher N-fixation and they can serve as transfer fertilizers for crops with high nutrient demand, e.g. field vegetables or maize. In the field experiment, different clover grass-based fertilizers (clover grass silage with two different application times, biogas residues from clover grass, clover grass pellets, fresh cut-and-carry clover grass biomass compared to composted manure, horn grit and an unfertilized control) are assessed in potatoes. The applied N for the different fertilizers is 100 kg ha⁻¹. In addition, the carry-over effect of the fertilizers to the following crop is assessed in summer wheat.

On-farm trials: The focus lies on fertilization with compost, the use of green manures e.g. high density seeding of field beans (*Vicia faba*) in vegetable production and the use of fermented plant materials after tillage of the green manures.

POSTER SESSION SCIENTIFIC CONTRIBUTION

Soil fertility in organic farming systems under biodynamic management – Design of a new long-term field experiment

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The success of crop production in organic farming

systems is to a much larger extent dependent on soil fertility than under conventional management. Therefore, the interest in soil fertility management has always been high in organic farming practice and research.

It has repeatedly been shown that the integration of animal and crop production on a farm provides the best basis for the management of soil fertility, due to the availability and the properties of cattle manure, and due to comparably high shares of perennial legumes in crop rotations that can be utilized as cattle feed. However, it is today also clear that animal feed production on arable land must be decreased for the benefit of food crop production to feed the world's growing population. Even though grazing-based ruminant keeping on grassland may be extended as a viable alternative, this means that the majority of farms in the future will have to manage with a low animal stocking rate, a lower availability of manure, or without animals at all. Against this background,

the recently established long-term field experiment at Oberfeld farm (Darmstadt/Germany) explores the potential of composted plant material from landscape management as a substitute for animal manure at different stocking rates between 0.2 and 1.0 LU cattle ha⁻¹.

The LTFE at Oberfeld (est. 2017) is the second location of the BoDyn LTFE on soil fertility in biodynamic farming systems. The location at Dottenfelderhof (Bad Vilbel/Germany) has been established on a site with K deficiency and, thus, includes K supply as a factor in the experimental design, but not cattle stocking rates. The experiment on K supply has been established already in 1997, but the actual design has been implemented in 2010. The link between the sites is provided by two treatments that are established at both sites, respectively (soil fertility management based on cattle manure according to the average stocking rate on organic farms 0.6 LU ha⁻¹ with vs. without additional plant compost).

POSTER SESSION
SCIENTIFIC CONTRIBUTION

Effect of differently prepared horn-silica-preparations on yield and quality of potato and spring wheat

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Usually the mineral silica is used for preparation of the bio-dynamic horn silica. In the 'agricultural course' Rudolf Steiner (1924) proposed to use orthoclase as well. In the present study the question of diverging effects between these two substances was investigated in field trials during three years (2010-2012).

In parallel, modified versions of the preparation were tested, whereby the rock meal of grinded, medium sized crystals was kneaded with soil, filled into the horns and sealed with pitch (according to R. Steiner, conversation note 1924).

The investigation was conducted in orthogonal field trials in potatoes (2010) and spring wheat (2011, 2012). In five repetitions the following treatments were applied: 1. Control (water), 2. Horn-silica, 3.

Horn-silica-soil, 4. Horn-orthoclase, 5. Horn-orthoclase-soil. The preparations were sprayed multiple times, at relevant times during plant development.

According to the results the potato variety GRATA showed only little different reaction to the diverging treatments. But a delayed flowering could be noticed, caused by the treatments: silica, silica-soil and orthoclase-soil.

Concerning the fresh matter content, a deviation of -5% could be noticed comparing the horn-silica treatment to the control. This led to a reduced nutrient removal of phosphorus, potassium and magnesium (-8 to -12%). On the other hand, the slightest darkening (oxidation) of the potato extract was observed in these treatments, which is considered to be a positive quality criteria.

The 'picture forming method' investigations showed

differences between the treatments by examining boiled potatoes.

Regarding vitality and lowest aging of the tubers the following ranking was observed: silica > silica-soil > orthoclase > orthoclase-soil.

The trial conducted on the spring wheat variety HELIARO® (2011) was affected by severe drought during spring and humidity during seed formation. As observed in the potato trial, flowering of the spring wheat treated with Silica was significantly delayed. Additionally, the silica treatment led to a reduced number of shoots, measured by a reduced plant density of 8%. No effect on the yield was found but application of preparations, in contrast to the control, led to reduced contents of the wet gluten fraction, resulting in reduced total gluten yield. Significantly reduced gluten yield of 13% was caused by the silica treatment. Generally, an increased content of carotenoids could be observed by the application of preparations.

In 2012 on HELIARO® effects of first treatment and repeated treatment, grown from farm saved seeds, were tested. Mainly differences between the treatments with diverging minerals (Silica/Orthoclase) were found. Treatment with orthoclase-preparations led to a reduction of the nitrogen and lutein content, compared to the control and to the silica treatment. All preparation treatments led to higher

gluten indices what is considered to be a parameter for improved baking quality. The sedimentation values were reduced by the preparation treatments but regarding the high baking quality values, this is negligible. Application of the preparations, especially of the orthoclase variants, led to increased values of secondary plant compounds. This effect is pictured by the increased carotenoid contents. The 'picture forming method' analysis outlined the most positive effect of the classical horn-silica-preparation.

In conclusion this experiment gave first evidences for the differentiation between diverse modifications of the biodynamic horn-silica/orthoclase preparation. However, this differentiation and assessment of the effectiveness of the variants is still in the very beginning. But overall, the classical horn-silica preparation showed to be most effective. Nevertheless, more attention should be devoted in the future to biodynamic preparations with orthoclase.

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POSTER SESSION SCIENTIFIC CONTRIBUTION

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The Preparations are an indispensable part of Bio-Dynamic Farming and Gardening. Stirring the Field Sprays Horn Manure Preparation (500) and Horn Silica Preparation (501) just before their application (500 on the soil, 501 on the plants) is a vital activity for Biodynamics.

Rudolf Steiner preferred hand stirring over machine stirring. In the fourth lecture of his Agriculture Course

he proposed to stir quickly at the periphery of the vessel until a very deep crater is formed in the middle, and then to change the direction in an abrupt way so that it bubbles and seethes in the other direction. In the following third answer, he insisted on intensive mixing with an intimate permeation. Very often people do not stir in such an intensive manner as Rudolf Steiner proposed. The stirred quantities got larger (Steiner stirred in a bucket), and the tools are not always adequate.

In my book of 2017, I make some propositions for

adequate tools. In many scientific publications, the stirring tools and methods are not or not exactly defined. We need a common language to communicate about the methods of stirring.

Here are some of my propositions:

1. For the description of stirring craters, I use the terminology of vortex theory (Lugt 1979 / 1983):

1.1. Moving the water from the centre of the vessel creates a potential vortex (like a tornado or a bathtub outlet vortex). It has the form of an Y. The water in the centre moves fast, the water at the periphery does not move. The water moves in laminar flow. That can even impede an intensive mixing.

1.2. Stirring near the centre of the vessel creates a Rankine vortex: In the centre a rigid body motion, at the periphery a potential vortex.

1.3. Moving the whole container and stirring at the periphery of the vessel create a rigid body motion: The whole mass of water is moving with the same revolutions per minute. The crater in the water has the form of a rotating paraboloid. Fast water movement as it happens when we stir quickly at the periphery of the vessel creates a rigid body motion with turbulence: Every bit of water goes its own way. A drop of ink in turbulent water spreads in all directions. In some few seconds, the whole water in the vessel is blue like the ink. Together with the turbulence of the intensive bubbling and seething created by the abrupt change of the direction, it produces an intensive mixture with intimate permeation. Conclusion: That is exactly what Rudolf Steiner wanted.

2. I make the movements of the water visible with the help of transparent vessels of acrylic glass, ink and little plastic dobbles.

3. I give descriptions of six methods of „hand stirring“:

3.1 With the bare hand in the water.

3.1.1 Out of the wrist: For small quantities. That also makes a very intensive bubbling.

3.1.2 Out of the shoulder joint or the elbow: For larger quantities. Bubbling is not so intensive as when stirring out of the wrist.

3.1.3 The combination of these two methods (Alex Podolinsky) has as effect a very intensive mixture.

3.2 With a hearth brush or similar in one hand.

3.3 With a tool with a larger handle held with both hands.

3.4 With tools on a vertical axe, moved by a crank.

3.5 With a suspended tool. That is a widespread method which allows stirring of larger quantities.

3.6 Stirring more than one vessel:

3.6.1 With connected suspended tools. It is ponderous.

3.6.2 One crank, six stirring tools in six vessels: For scientific research, one person can stir more than one preparation at the same time. (Dr. U.J. König, www.Forschungsring.de)

Further research is needed. The importance of intensive stirring was not a subject of research until now. To that question, I can only tell my personal impressions: It is invigorating and it seems to make thinking easier.

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<https://www.duengerpreparate.ch/en/>

AGRICULTURE, FARM ORGANISM AND ENVIRONMENT

SCIENTIFIC CONTRIBUTION

Agriculture practices supporting biodiversity conservation in Mediterranean Areas: A meta-analysis

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A key element of biodynamic farms is the protection and enhancement of biodiversity. As the global awareness increases that farmlands can play a key role in supporting biodiversity conservation – there is a need for synergies between the practice developed on biodynamic farms and biodiversity conservation on regional scale. The aim of this study is to identify wildlife-friendly farming practices, which may be incorporated into Mediterranean agriculture. The focus of the research was on identifying scientific evidence for the contribution of various agricultural practices in Mediterranean climates. An additional aim is to identify knowledge gaps and directions for future research. We conducted a meta-analysis of 119 agri-ecological field studies, that were conducted in Mediterranean climate areas, and included quantitative evaluation of the influence of agricultural practices on the conservation of various taxonomic groups. The farms under investigation were conventional, organic and biodynamic. 17 biodiversity supporting agricultural practices were identified. Fact sheets were constructed: to identify agricultural practice requirements, the taxonomic groups and the conservation goals affected by each practice, possible effects on agricultural

production (positive and negative) and the degree of scientific evidence for the contribution biodiversity conservation. The highest evidence base for biodiversity conservation were for: hedgerows, cover crops in plantations, preservation of natural patches in agricultural land and preservation of agricultural landscape mosaic. These finding illustrate in a practical sense the biodynamic core value of farm organism. Meaning, agricultural practices with spatial impact, that integrate natural habitats with agricultural land, have the highest scientific evidence for biodiversity conservation – thus the farm organism, on a spatial level, receives a scientific reinforcement.

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Cross-scale effects of resilience – from soil resilience to farm resilience

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Humanity is facing an accelerated global change, whose tremendous consequences will essentially shape the next couple of decades. Soils are the nexus of food, energy and water which makes them key element to sustainable land management. The challenge for farmers will be to find sustainable practices in times of growing resource scarcity and economic pressures. The challenge for scientists will be to evaluate these agro-ecosystems regarding their sustainability, hence to find parameters that reflect all significant, especially subtle, effects within this complex socio-ecological system and to provide recommendations to farmers for strengthening soil and farm resilience.

Resilience is often promoted to be a boundary concept to integrate social and ecological dimensions of sustainability. It is described as the capacity of a system to cope with disturbances and maintain ecosystem functioning. Therefore, resilience is a promising parameter when it comes to evaluating sustainability of soil management practices (Ludwig et al., 2018), since it reflects both its highly interlinked ecological and management components.

In this study we try to evaluate the agro-ecosystem resilience on the farm level, with special focus on the farmer as the socio-ecological driver of local soil resilience due to his individual farm management. The farm in this context is considered as a systemic organism, with an own 'farm individuality' characterized by the complex interplay of individual farming practices and site conditions. Organic and especially biodynamic farm management is assumed to increase soil resilience actively by methods like the application of biodynamic preparations, while conventional farming rather maintains resilience passively by giving the soil time to rest and restore on its own. We hypothesize that a flexible and dynamic taking-over of few key principles of organic farming to conventional farming increases soil resilience considerably.

Therefore, a set of 32 organic/biodynamic and 3 conventional farms in the Lake Constance region was selected, representing a huge variety of farm types in Germany, Austria, Switzerland and Liechtenstein. These farms will be given financial support to realize their individual concept of preserving soil fertility. The application of their individual soil fertility measures will be accompanied by this study for the next 4 years. Effects on resilience will be evaluated by merging existing methods from ecology and social science. Methodological approach and first results will be presented.

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Comparison of the biodynamic concept of farm individuality with actual concepts of individuality in biological science

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Farm individuality is the central concept of biodynamic agriculture and all practical measures are deduced from it. This individuality is composed by all biotic (plants and animals) and abiotic (earth and atmosphere) elements of a farm. Rudolf Steiner justified this concept by exposing the relations and correspondences between soil, plants and animals (Morau 2018). The question is how this concept is related with actual scientific concepts of biological individuality.

To answer this question, a literature review had been conducted in fields of philosophy of biology and biology (including evolutionary theory, ecology and physiology).

The concept of biological individuality is a major issue in biology and philosophy of biology. Traditionally, a biological individuality was considered as a spatially discrete living entity. However, the necessity of physical continuity had been challenged as colonies of social insects or symbiotic associated species had been described as individualities (Wilson and Sober 1989, Queller and Strassmann 2012). In ecosystem ecology, multi species individualities include abiotic parts as well (Turner 2000, Bouchard 2009). These concepts had been mainly developed in the evolutionary or physiological biology. In the last approach, the individuality is considered as a functionally integrated assemblage of biotic or abiotic parts (Bouchard 2009). In this sense, abiotic parts like moulders of a termite colonies are considered as physiological parts of an "extended organism" (Turner 2000).

Rudolf Steiner described the farm individuality as an assemblage of biotic or abiotic parts with a functional approach as well. Indeed, this individuality is based on physiological processes that correspond to human physiology ("head" and "belly" processes). This comparison is based on the unity between plants and animals as the processes in the roots and aerial parts of plants are related to those in the neuronal and metabolic system of animals, respectively. Noteworthy, these correspon-

dences have recently been gaining in support through advances in molecular plant biology showing that roots are comparable to neuronal systems (Baluska 2009).

Therefore, the biodynamic approach considering a global "farm physiology" can be considered in light of the "superorganismal physiology" in the sense of Turner (2000) and Bouchard (2009). The underlying question is the same as in physiology: how heterogeneous components interact and constitute a cohesive whole that persists through time. To answer this question physiological concepts have been developed that can be very useful to establish the corresponding concepts for the biodynamic agriculture. For example, the concepts "immunity" (i.e. the unity that underlies the plurality and gives the cohesion of the whole) and "homeostasis" (the coordinated physiological reactions which actively maintain the stable state of the body) are related with the agronomic concepts "home advantage" and "resilience", respectively.

In conclusion, the concept of farm individuality is related to concepts developed in physiological biology and ecosystem ecology. These correspondences open new ways to discuss, assess and develop this concept in the agricultural science and practice.

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Bottle and Bolt Model: the eco-friendly concept for controlling crop losses

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Today, one of the main global challenges is how to ensure food security for a world growing population whilst ensuring long-term sustainable development. In recent years the number of wild animals migrating to the agriculture fields due to degradation of forest cover and overgrazing in the forests is increasing day by day. The major drivers of this change include food competition between wild and domestic cattle, uninterrupted tree cutting and overgrazing. The blue bull (*Boselaphus tragocamelus Pallas*) is biggest Asian antelope and is one of the most commonly invader in central and northern India. Crop raids by blue bulls have been widely reported in all villages adjacent to the forests and even beyond it. Such raids do considerable damage to crops, vegetable fields and orchards, sometimes ruining an entire harvest in a single nightly event. Further, because of their short gestation period and high reproductive potential, the population of blue bulls has exceeded over carrying capacity of the natural habitats resulting in their migration to crop fields. Their huge population size started damaging the crops for filling their belly. This crop damage gives the farmers major monetary losses. The extent of crop damage has reached 50-70 % in India. Since according to the forest and wildlife conservation act they come under the category of conserved animals it is an offence to kill or harm them. Blue bulls are very robust and they can easily cross six to eight feet fence and even can uproot the wire fencing by different ways. They dug the fence from bottom and the male bluebull inserts its head in the dug portion and by standing with the strength of its shoulders uproot the entire fence. These blue bulls come in groups at night, enter the field and damage the entire crop by eating the soft and tender portion of growing plants. if the plants are at early stage then

the farmers can get some yield but if the attack is at advanced stage the losses are up to hundred percent. The bulls attack the field crops as well as vegetables and orchards and the losses are really great. In some cases the attack is at mature stage so that nothing is left in field to harvest. Generally they prefer different crops like maize, mustard, gram, chillies, cauliflower, cowpea, black gram, cabbage in the mature growth stage while wheat, barley, potato, radish and pumpkin in the early stages. On an average, an adult blue bull needs 14 kg of dry biomass of palatable tree species (420 kg per month). The annual economic loss to each farmer is about Rs. 9,000 – 11,000 per year. To control this farmers are innovating different measures and a very innovative method is bottle and bolt model. In this method empty beer bottle is hanged from a support maybe a tree and a long thread/rope is tied very near to it with an iron bolt touching the bottle. At the lower end of thread or rope is tied a light weight cardboard or thick paper painted with silver luminescent paint. When the wind or gentle breeze blows at night the cardboard /paper moves back and forth along with the wind. This forces the iron bolt to strike to the bottle making a high frequency beating sound. This sound covers a large area in open fields at night forcing the wild animals particularly the blue bulls to run away from the area. The painted cardboard/paper also rotates very fast frightening the animals. If such structures are placed all along the fields there is full control of blue bulls and wild boars. Such an approach is very successful in India and control of many other wild animals is also possible. This approach can be upscaled at many other countries in Asia, Africa and Tropical America where the losses due to wild animals are great. This is very cheap and ecofriendly method. In one Dollar fifteen such models can be mounted. This is very easy method and does not require any technician or qualified person for its manufacturing and mounting.

Symbiotic relationship between wine plants and the grassociety between the lines

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Research question

Is the quality of the organoleptic results of a wine due to the ecological and symbiontical situation between the wine plant and the grass society between the lines?

Research methods

In a wine yard there are the wine plants planted in an area and the natural grass plant society.

1. The floristic enumeration of the plant species in the wine yard gives us the biodiversity of the plant society in relation to the geological site of the wine yard.
2. The wine plant sort, resistant or not, has an intimate relationship between itself and the environment. Determination of the symbiotic relationship. We com-

pare different geological and geographical wine yards with the same cultivation system.

3. The organoleptical result of the wine will determine the positive or negative relationship with his environment.

Results

More the biodiversity is great and relationship between wine plant and his environment is natural, more the wines growing there gives marvellous organoleptic results.

Conclusion

Wine plants and the grass plant societies have a natural relationship, wine plants phagocytes the grass plant society to transform them to very rich biodiversity societies. This relationship gives the possibility to the wine plants to develop the marvellous aromatical background for great biodynamic wines.

Tree-ring stable isotopes for reconstructing climatic and environmental changes through time: a study on air pollution changes and potential applications in the quality assessment of agroecosystems

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The study of tree rings is the main subject of dendrochronology, a scientific discipline that was first described and defined in its main principles by the American astronomer A.E. Douglass in Tucson (Arizona) with his work in the field of archaeology (Douglass, 1929). After approximately one century since then, given its power in yearly dating the tree rings, dendrochronology has greatly evolved in many fields,

becoming the main contributing discipline in continental climate reconstructions for pre-instrumental periods up to the early Holocene, in the spatio-temporal reconstruction of environmental changes due, e.g., to geomorphological processes or to pollution events, and in climate change impacts on forest ecosystems.

Traditionally the main parameter used is the ring width and the analysis of site chronologies and of growth changes, however in recent decades the study of the chemical and isotopic composition of the cellulose annually synthesized and progressively deposited

in the annual rings, has opened new opportunities for reconstructing past and ongoing changes occurred in the environment around the trees (McCarroll and Loader, 2004). Tree-ring stable carbon and stable oxygen isotopes in the wood cellulose in fact directly reflect the physiological conditions of the trees during the growing season, allowing to 'read' and date information on the efficiency of the photosynthetic process, on possible water stress experienced by the trees, on their use of soil or ground water, and on environmental changes occurred in the past or still ongoing.

I here propose a case study recently revisited, about the impact of air pollution on trees growing along the Mt. Blanc highway, close to the Italian side of the tunnel entrance (Leonelli et al., 2012). The highway is often congested close to the tunnel entrance and the vehicles passed from approximately 2 million (M) per year in 1998 (with ~0.8 M trucks and buses) to zero in the next three years because of the tunnel closure after a dramatic car accident and fire occurred in March 1999. Since 2002, the traffic has increased again reaching ~1.7 M vehicles in the following decade. With the aim of detecting possible signals recorded by the trees due to the occurred changes in air pollution, together with other researchers I have analyzed the isotopic signature of the tree-ring cellulose in European larch (*Larix decidua Mill.*) specimens at three sites (one along the highway, the other two as control sites) over the period 1985–2008. It was possible to detect an absence of climatic signals in the stable carbon isotope chronology for the trees directly exposed to vehicles emission. Moreover, the new analyses that I performed on the chronologies of both the stable carbon and oxygen isotopes, clearly show that in 1999 (the first year with no emissions

during the growing season), the trees along the highway experienced an enhancement in photosynthetic rates likely in relation to the absence of air pollution, whereas the trees from the two control sites in this year showed a year with no particular environmental stress, with high stomatal conductance during the growing season.

This case study underlines that tree-ring stable isotopes are highly sensitive to climatic and environmental changes: the possibility to detect changes in the environment and to precisely date them, opens the possibility to evaluate ongoing trends. Moreover, this technique could be applied in the quality assessment of ongoing environmental changes e.g. in farms passing or passed from intensive to organic agriculture (if trees are present in the fields or in their vicinity), or to evaluate and precisely date with annual resolution the impact of past or recent soil/air pollution events occurred in specific components of an agroecosystem. Moreover, this technique can be used also with a more traditional approach for assessing the ongoing climate-change impacts on source waters used by trees and on tree health and growth.

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POSTER SESSION OBSERVATION REPORT

Diversified farm: A perennial food basket in arid zone

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The case study presents a precise review of Mr. Madan Lal Deora, a progressive farmer of Pali, district

of Rajasthan in India who had established himself as a successful farmer adopting diversified farming system. He had adopted multiple cropping and farming system on his farm which is 2.5 hectare in area by

growing legumes, cereals, oilseeds, pulses, medicinal plants and forest plants along with horticultural crops including fruits and vegetables. The case study is an excellent example where one can find more than 100 cultivated and natural species of plants growing in close harmony supplementing each other. The crops include wheat (*Triticum aestivum*), maize (*Zea mays*), barley (*Hordeum vulgare*), oats (*Avena spp.*), jowar (*Sorghum bicolor*), bajra (*Pennisetum americanum*), mustard (*Brassica nigra*) and til (*Sesamum indicum*). In spices one can find cumin, fennel, fenugreek and dill in fruits the major plants are Drumstick (*Moringa olerifera*), Ber (*Zizyphus mauritiana*), Mulberry (*Ficus alba*), Jamun (*Sygium cumuni*), Aonla (*Emblica officinalis*), Custard apple (*Annona squamosa*), Gonada (*Cardia myxa*) and Fig (*Ficus carica*). In vegetables the farmer is growing mint (*Mentha Arvensis*), spinach (*Basella alba*), okra (*Hibiscus esculenta*), tomato (*Lycopersicon esculentum*), ginger (*Asarum canadense*), red and green chillies (*Capsicum annum*), carrot (*Daucus carota*), coriander leaves (*Coriandrum sativum*) and fenugreek (*Trigonella*). The farm structure contributes to biodiversity, a diverse and esthetically pleasing rural landscape, and open space. In wild plants we can find Phog (*Calligonum polygonoides*), Angreji babool (*Prosopis juliflora*), Bordi (*Zizyphus nummularia*), Lana (*Haloxylon salicorniourn*), Bawli (*Acaacia jacquernontii*), Gugal (*Cornrniphora wighti*), Henna (*Lawsonia inermis*), Anwal (*Cassia ouriculate*), Kair (*Capparis decidua*), Ber (*Zizyphus nummularia*) and Kheep growing on the farm boundary. In general, we can see an entire biosphere of the arid zone vegetation with cultivated plants in a small farm. The farm embodies a diversity of cropping systems, of farming systems, of landscapes, of biological organization,

culture and traditions. The forested areas from which wild foods, and leaf litter are extracted, the wood lot, the farm itself with intercropping, agroforestry, and large and small livestock, the fish pond, the backyard garden, allow for the preservation of hundreds if not thousands of wild and cultivated species. Proper management of the natural resources of soil and water, produces significant environmental benefits for society. The benefits of farms extend beyond the economic sphere. To begin with, Mr Madan utilize a broad array of resources and have a vested interest in their sustainability. At the same time, his farming system is diverse, incorporating and preserving significant functional biodiversity within the farm. By preserving biodiversity, open space and trees, and by reducing land degradation, the farm provide valuable ecosystem services to the larger society. Along with agriculture the farmer is having livestock which yields milk and the dung is converted into valuable vermicompost. He had also turned himself into an entrepreneur by processing and value addition to his farm produce through a tunnel drier. The solar tunnel dryer is a poly house framed structure with UV-stabilized polythene sheet, where products on large scale could be dried under controlled environment. The enterprise consists of different value added products of typical Indian fruits and vegetables including juice, squash, candy, powder, pickle, dry aonla, churan tablets, preserve and ladoos. All the products are purely organic have high demand in the local and regional market Thus this model of multifunctional small farm which integrate crops, horticulture, livestock and natural vegetation is key to sustainable development in countries dominated by small farms.

POSTER SESSION

OBSERVATION REPORT

Innovative couple turning barren soil to productive land

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In Jaitaran, a region in Pali India, Chain Singh and his wife are running an organic arable farm. The farm, around 20 hectares, is a family farm for many generations. The farm is located in a polder of reclaimed

clayey loam soil. On getting aware of hazards of the impact of chemical fertilizers and pesticides on the environment, Mr Chain Singh decided to go for organic agriculture and convert the farm into an organic farm, as organic certification is strictly controlled and has clear criteria for certification. Besides their concerns about the environment, he also undertook an oath to

uproot (desi babul) *Prosopis juliflora* from his village and surroundings as it has now turned to be major weed covering vast areas. Today, they run the farm together and actively follow innovations in agroecology. They collaborate with their neighbours by exchanging knowledge, experiences, labour and machinery. Crops are grown without the use of pesticides and chemical fertilizers; therefore, crop rotation forms the basis of the farming system. The crops are grown in a 3-crop rotation, which means that the same crop is grown in the same field only once every three years. A very unique crop rotation devised by Mr Chain Singh is Wheat, Mustard, Cumin system in which mustard residue acts as disease controller for the wilt and blight in cumin crop along with good yield. In addition, crops facing threats from the same or similar pests are not grown in bordering fields or in a sequential season in the same field. Also crops requiring high nutrient inputs are not grown in sequence in the same field. The main crops are green gram, clusterbean, cumin, chickpea, mustard, fennel, barley, oats and wheat. Leguminous crops like chickpea, clusterbean and green gram have less water requirement and fix nitrogen which the other non-legume crops need. A useful method to remove weeds before sowing the crop is through the preparation of a 'false seed bed'. The preparation brings weed seeds to the soil surface; the seeds receive daylight which activates germination. The germinated weeds can be hoed and mixed in soil. Without the use of additional inorganic/chemical fertilizers, green manures are an important aspect of the agroecological farming system to ensure sufficient nitrogen for the crops. Besides the crop rotation, green manure crop is sown in rains and mixed

in soil when still soft and tender. The farm fields are bordered by Napier grass/safflower margins. These margins prevent run-off of minerals from the field into bordering ditches. In addition, they attract natural enemies for pests in the crops, provide habitat for pollinators and have an esthetical value as well. Soil health is a major issue at the farm, as on any farm. Since the transition to an agroecological farming system soil health has increased. Over the past four years, soil organic matter (SOM) has increased several decimals. In general, the crops give high yields without any additional chemical fertilizers. The farmer is happy to cultivate crops for a market with demand for organic crops and the way of cultivating agroecologically gives a lot of satisfaction. During the cropping season, once every two weeks they organise farm visits and field demonstration. They discuss possible solutions, their own experiences and they also share innovations in agroecology. As they sell their crops directly to retailers and the organic market is rather transparent, being part of the association helps their bargaining power on the price of their products. There is also collaboration with researchers also. The State agriculture department and university use data from the farm as well conduct front line demonstrations on the farm. In return Chain Singh and his wife share their practical experiences with the researchers such as the challenges, the manure management that works best, practices that work well, etc. These improvements focus on building the knowledge and skills of farmers to improve their analytical skills and capacities to innovate and control their farm system which needs to be out scaled.

POSTER SESSION
OBSERVATION REPORT

Interlinking the chains of success: biodiverse farm in arid zone

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The small biodiverse farm model is the surest route to broad-based economic development as they are multiple functionaries and provide immense benefits for society and for the biosphere. In food production,

small farms are more productive and more efficient. With regards to cost and return, a small farm economy offers a clear solution. Thus, A small farmer can intensify biodiversity and the greater the biodiversity, the higher the productivity and stability and sustainability of agriculture. The case study presents the successful experiences of a farmer Mr Deda Ram

from arid zone of Rajasthan, India who has conserved traditional land races since decades and promoted their expansion. The most prominent landrace is kharchia wheat as this is the only variety which can adapt to harsh local conditions of saline soil, saline water and high temperature and can still give good yield however bad the situation is. The soil and water conditions in his locality are very poor and both the parameters have very high pH (8.6) and Ec (5.6) values. Under these conditions the growth of any other crop is very poor and the yield is negligible. The local land races can only survive and resist biotic and abiotic factors in these circumstances. Further he is taking Green gram and Cluster bean on part of soil as rainfed crop. These are leguminous crops and fix nitrogen in soil through the root nodules present in soil besides improving soil fertility. To stop soil erosion and conserve soil moisture he is growing local land race of watermelon which is having very extensive root system and spreads in large area. This watermelon yields considerable amount of seeds which are very much in demand due to their unique taste and use in food and pharma industries. This creeper binds the soil and prevents the legumes and pulses from being uprooted by high velocity winds. There is hardly any application of fertilizer or chemicals. The soil fertility is maintained by permitting and giving shelter facilities to sheep and goat herds that stay in his field at night and in turn their excreta and urine rejuvenate soil fertility. He practices deep summer ploughing and leaves field as such during monsoon to conserve moisture. In winter season he takes kharchia wheat, chickpea and yellow mustard on the conserved soil moisture.

The trust in native land-races and crop varieties, and the ever-evolving capacity of farmers to innovate and adapt, once seemingly lost, is making a comeback in this arid zone and farmers there are demonstrating a new maxim to be applied in the management of agricultural species diversity: "sustainably use it or lose it". Such type of on-farm conservation bears pragmatic cooperation and marketing potentials as farmers are forming coalitions around heirloom varieties with a vision of local development, challenging the idea of a conflicting polarity between 'modern/viable' vs. 'old/outdated' varieties. At this point, 68 households are cultivating land-races and local varieties in his village and more than 80% of these households are reporting higher pulse diversity on-farm, diversification of the family diet, and higher nutrition levels. The revived landraces and local varieties have demonstrated a much higher resistance to droughts, pests, and harsh environment. Fifteen farmers and three farmer co-operatives confirmed higher incomes from trading of their harvests and seeds. For the last three years the volume of sales has been growing at almost 100% every year. While the sales revenue for the farmers has been on the rise, further financial returns are gained through almost zero application of chemical fertilizers. Thus, Small family farms are the backbone of a community, a nation, and of society as a whole. Small biodiverse farms based on internal inputs are in fact the only promise for increasing agricultural productivity, whether productivity is defined in terms of biological productivity or in terms of financial returns, or in terms of energy

POSTER SESSION
OBSERVATION REPORT

Rainwater harvesting for food security and sustainability in arid zone

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In many areas traditional farmers have developed and inherited complex farming systems with agri-avenues which are highly adapted to local conditions, allowing them to manage production in harsh environments also. Mr. Taju Khan an innovative farmer of in district

Pali state of Rajasthan, India explored options for farm diversification under hot-arid conditions at his farm using agroecology principles. His motivation brought him to KVK, CAZRI where he was trained on very basic aspects of rain water harvesting. He made a rain water harvesting structure at the point where excess water is collected and overflows during rains.

With initial success and constant motivation, he further constructed concrete rainwater storage structure and became very resourceful about his endeavour. He developed innovative schemes to increase his output such as directing overflowing rainwater into his pond, developing fruit orchard of arid fruit ber, taking intercrops in orchard, cultivating fodder grass for livestock, rearing fishes in his pond etc. The other idea he started implementing was to dig pits and deep trenches in the soil in his land at regular intervals to direct the flow of rainwater from the field slopes into the trenches. He continued the process of digging new pits and trenches and also desilting the older ones. This rainfall is sufficient for all field activities of farm provided it can be stored in soil and some structure. For the same he constructed the trenches made on the sloping roads that allow the water to flow inside the farm to percolate in the soil. Further he followed strip cultivation in which he made ridges and furrow and thus he could trap the entire water in his field itself. In his orchard he made circular catchments around the trees and thus he could harvest the entire water in his orchard. His selection of crops and varieties is also very unique as he grows arid legumes and pulses which can survive on minimum rains received and are drought resistant. Secondly, they are insect and pest resistant and fix nitrogen in the soils due to nodules present in their roots. He takes kharif (rainy season) crops on the rains received during rainy season and rabi (winter season) crops on conserved moisture supplemented with water stored from rain water harvesting. The yield from his farm now in-

cludes wheat, mustard, chick pea, sesame and green gram, ber fruits, fishes from ponds, besides the yield of variety of other wild species that provide him a considerable amount of profit and that too from a land that was written off as barren a few years back. Presently productive activities, family labour mobilization and diversification contribute to a stable and lasting family-based enterprise. This experiential learning also led to new knowledge emerging from interactions among hitherto powerful scientific hierarchy and served as role model for other farmer's adoption. The above case story of Mr Taju Khan sustainable intensification drawn from across India shows that if there is a strong will and determination then food outputs can be increased not only without harm to the environment but also in many cases to increase the flow of beneficial environmental services. Such improvements then contribute to domestic food budgets, foster new social infrastructure and cultural relations, help the emergence of new businesses and so drive local economic growth, and ultimately improve the well-being of both rural and urban populations. The case study contains many different technologies and practices involving agricultural research, building social infrastructure and developing new options. The experience secure livelihoods so that farmers can produce food that is safe, adequate and nutritious for a growing and urbanising society. Such agroecologically farming will remain more resilient to climate change. The experience also reports benefits to soil fertility, water retention and supply, drought mitigation and conserves biodiversity.

POSTER SESSION
SCIENTIFIC CONTRIBUTION

A soil carbon baseline for a biodynamic farm in Costa Rica

Solano Danilo

Asociación de Agricultores para la captura de carbono en Costa Rica. Finca Luna Nueva, The Carbon Underground.

Simply reducing emissions will not sufficiently limit global warming; it is crucial to put some of that carbon back into the soil and into living ecosystems, like grasslands and forests. This notion, is known as carbon farming. Nearly all the carbon that enters the biosphere is captured during photosynthesis, and as

it moves through life's web, every organism takes a cut for its own energy needs, releasing carbon dioxide as exhaust. This circular voyage is the short-term carbon cycle. Carbon farming seeks to interfere with this cycle, slowing the release of carbon back into the atmosphere. The idea is to change the flow of carbon so that, for a time at least, the carbon leaving a given ecosystem is less than the carbon entering it. Some of the most common land management practices in the

tropics consist of cropland management, graze land management, and native ecosystem management. What is unclear is which practice is most efficient for sequestration of atmospheric carbon in the soil, and how to optimize the systems to be more efficient. The trial site is laid out on the Finca Luna Nueva Biodynamic farm located on the what is known as the wet humid tropics, a trial is designed to: test whether managed grazing, rotational crops, or reforested rainforest would be more efficient at sequestering atmospheric carbon. The trial site consists of 27000 m² of managed graze lands, 27000 m² of rotational croplands, and a reforested section just to the North of the farm. Average altitude of the sites ranges from 330 m to 350 m. Soils across the graze lands and cropland are typical young inceptisols found in the tropics, and andisols in the forested part. In each of the land management areas, 15 sample sites are chosen at random and then marked with GPS to allow for future testing. At each sample site a 100 cm by 100 cm hole is dug to a depth of 150 cm. This allows for viewing of the soil profile, root depths, and soil sampling. In each of the previously identified sample sites with their corresponding soil pit, three depth profiles are sampled: 0-30 cm, 30-60 cm, and 60-100 cm. Drilling into the face of one wall of the pit horizontally, 5 samples are extracted using a soil sample auger from each depth of the three depth profiles. These 5 samples per depth are composited and then 300 g are taken and sent for lab testing. They go through a combustion process to ensure that all organic carbon is ignited and the CO₂ given off is measured, resulting in a percentage of organic carbon present in the soil. From this number, the organic matter is calculated using the Van Bemmelen factor of multiplying the soil organic content by 1.72. *STATISTICS WERE CALCULATED USING A BIOSTATISTICAL SOFTWARE CALLED

INFOSTAT*In 1 meter depth a significantly different percentage of carbon was observed (4.05) %for the treatment or management called secondary forest. Then the crop rotation management (3.47)% follows but is not statistically different from Rotational grazing management (3.27)%. P-VALUE OF 0.0001When fragmenting the carbon in different layers the values are as followed:0-30 cm depth:Forest treatment is significantly different: (2.86)% , followed by Crop rotation treatment with a value of (2.05)% and Rotational grazing management with (1.51)%. P-VALUE OF 0.0001.30-60 cm depth:P-VALUE= 0.0358. 60-100 cm depth: For this layer, the farming practice or management that showed more carbon percentage was Rotational Grazing with a value of (1.36)%, followed by Crop Rotation (0.78)% and Secondary Forest with (0.64)% P-VALUE OF 0.0001CONCLUSIONS The soil surface increment, 0-10 cm, generally contains the highest levels of short-chain labile carbon, this is due to the top soil biomass and the soil food web. This surface increment is not where one would be looking to safely store atmospheric CO₂. The deeper in the soil profile that carbon is found, and the more humified the carbon, the better.

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FOOD QUALITY, NUTRITION AND HEALTH

SCIENTIFIC CONTRIBUTION

The vitality of cucumber fruits from different cultivation systems – a new method for assessing antimicrobial, slice healing and green colour retention properties of cucumber fruit

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Research question

A challenge in biodynamic research is to develop concepts and methods corresponding to the basics of biodynamic agriculture and food production. Here the concept vitality, or vital quality, is widely used, and correspondingly various complementary methods have been developed including picture-developing and degradation methods, reflecting specific vitality aspects. In the latter case e.g. grated/sliced vegetable samples are exposed to stressful conditions, after which antimicrobial properties, dry matter loss, enzymatic activity a.o. are determined (Ahrens 1991). Still, there is a need for methods combining antimicrobial properties and characteristic of healthy organisms such as wound healing. The concept of germination vitality – the ability of seeds to germinate under field conditions (Hampton & TeKrony 1995) – may be generalised into an overall vitality concept: ‘the ability of living organisms to perform their life processes and life cycles under stressful conditions’. Research method: A method developed for assessing the antimicrobial, slice healing and green colour retention properties of fruits of cucumber (*Cucumis sativus*). The slice healing properties are based on a complete slicing into 15/20mm slices. These are manually ‘reassembled’, wrapped in plastic foil and placed in a heating cabinet at 23.50C for 14 days. After unwrapping the response parameters are scored. A maximum slice healing score implies that the 16-20 slices have grown together so that they can be held horizontally, manually at the 3-4 bottom end slices, without breaking. Fully ‘healed’ samples, with no sign of microbial attack, are re-tested for additional 7 days. The method was tested for

the ability to differentiate samples from two Danish producers, selected as golden standards for modern, large-scale conventional resp. organic deep-soil producers, and to differentiate Polish and Slovenian samples from small-scale conventional, organic and biodynamic producers. Based on transformed score data logistic regressions were performed, including data on country, calendar week, cultivation system, growth medium and sample diameter, length and weight (Andersen et al. 2018).

Results

The difference in slice healing and antimicrobial properties of the Danish conventional and organic samples from 7 weeks was highly significant ($P < 0.0001$). Conventional samples showed signs of microbial attack after 5-7 days, with minimum scores of slice healing after 14 days, while the majority of organic samples showed no signs after 14 days and max scores of slice healing properties. Hence only a minority of the conventional samples were retested, as opposed to the majority of the organic samples. Statistical analyses of data from Polish and Slovenian samples are ongoing, and from the cucumber content of dry matter, nitrate and antioxidants.

Conclusion

The newly developed method for assessing the antimicrobial, slice healing and green colour retention properties of cucumber fruits has demonstrated a highly significant ability to differentiate samples from conventional and organic cultivation systems. The combination of the three response variables is here seen as a relevant indication of the vitality of cucumber fruit samples. Ongoing statistical analyses will clarify if older-variety East-European samples have maintained to a higher degree their vitality, as

compared to modern, highly-bred West-European varieties, as well as the correlation between the three scoring variables and nutritionally relevant indicators. Finally, it is the experience of the author that the method is a most valuable teaching and communication tool in relation to producers, consumers and decision makers.

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SCIENTIFIC CONTRIBUTION

Biodynamic milk and its potential health aspects

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Background

In the expectations on biodynamic agriculture several issues were mentioned in relation to health aspects of milk: the horns on cows as well as the homogenisation of the milk, two issues that were written as prerequisites in biodynamic regulation.

Goal

In this review studies on milk quality will be reflected how biodynamic milk quality might affect health. The following aspects will be evaluated:

- How do biodynamic regulations affect the milk fatty acid composition in a European context?
- How can biodynamic milk be differentiated based on -omics composition?
- If horns affect animal's physiology, how can milk from horned and dehorned cows be understood?
- How can mice models explain, why raw biodynamic milk prevents for milk allergy and asthma?
- What is the outcome of epidemiological stud-

ies on the effect of heat treatment, omega-3 (n-3) fatty acids in relation to asthma and allergies?

Results

Milk fat contains a range of bioactive fatty acids (FA). The most promising FA in relation to health promotion are the n-3 FA, CLAs, butyric acid and branched chain FA. Each milk origin has its own character, which is visible as a profile, a fingerprint. Around 80 single FA are used to differentiate milk origin and factors involved: grass intake, meters above sea level, season of production, level of maize and concentrate in the ratio, but also horn presence. Within a European context, biodynamic farms in Nordic countries tend to follow the principle of intensified feeding with concentrates and conserved fodder. This negatively affects the FA profile. The best premises for a high FA quality are found, if cows are fed grass. In summer the most worthy fat is produced, if cows get fully access to pasture.

Several 100s of metabolites are found in the metabolomics analysis of the defatted milk serum. These metabolites are up- or down-regulated in the milk expression due to the milk production level, type of fodder, health and disease status of the cow, but also due to the presence or absence of horns. The outcome of lipodomics and metabolomics was used to

differentiate milk from horned and dehorned cows. Although horns are generally seen as weapons, ruminating animals use their horns for additional heat regulation.

Three experiments were done in regard to horns, and horned cows showed a higher overall level of metabolism than dehorned cows. Cows have the possibility to use either fats or sugars for heat production. Under low ambient temperatures cows get in conflict between milk production (lactose from glucose and C3-molecules) and the maintenance of their body temperature. This physiological competition can be seen as a shift in the FA towards a reduction of odd chain FA (C7:0, C9:0, C11:0) and an increase of several long chain unsaturated FA. The origin of odd chain FA is propionyl-coA, which becomes in conflict with glucose building for energy purpose (Baars et al., 2019).

It was hard to see a differentiation in the proteomic profile of horned and dehorned cows, probably because of the small effects and the reduced sample size.

In the gut flora of horned and dehorned heifers a differentiation was possible, although differences were small and it was unclear, what the differentiation meant.

In a clinical trial biodynamic milk was tested in multiple allergic children. Children were provoked with raw biodynamic Vorzugs-milk as well as shop milk (conventional, pasteurised, homogenised). The same milk was tested in an allergic mouse model. Children and mice showed the same results: raw milk did not bring forward an allergic reaction. In an asthma mouse model the raw biodynamic milk was compared with heat treated milk (80°C, 10 min). Mice did not develop any asthmatic reaction on raw milk, in contrast to heat treated raw milk.

These experimental outcomes are in concordance with epidemiological studies in children and no correlation was seen between the consumption of raw milk and the development of asthma, allergies and hay fever later in life. There was an independent protection of raw milk consumption in relation to farm life. These studies were almost exclusively done on conventional farms.

Another factor in relation to the development of asthma and allergies was the intake of omega-3 FA.

Biodynamic milk contains generally High amounts of alpha linolenic acid, which is one of the strongest differentiation outcomes between biodynamic and conventional milk, especially if milk is compared at a regional level.

Conclusion

In the relation between milk and health, biodynamic farming could support several health aspects in relation to milk quality. Biodynamics can positively affect the fatty acid spectrum, depending on region and season. If milk gets pasteurised, milk loses its potential to prevent for asthma and allergies, even if milk is from low-input biodynamic origin. The horns on cow affect the animal's physiology, which can be shown in the change of milk metabolites and milk fatty acids. Cows used their horns to support their metabolism.

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San Francisco Farm Demeter Bananas, nutrition and human development: emphasis on the etheric of the food.

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This article emphasizes the relationship between biodynamic agriculture, will nutrition (digestion of etheric of the food) and how San Francisco Farm (SFF, Brazil) has developed these questions. The two other nutritional components will not be developed here. Human actions result from a complex relationship between will, thought and feeling. The future of the earth depends on the human will. Exacerbation of self-interest (economic life) and illusion (materialism) lead the human being to both social and nature erosion.

“This is a nutritional problem” replied Steiner. “How food is constituted nowadays no longer provides men with the force to manifest the spiritual within the physical. The bridge between will and thought can no longer be established. Food plants no longer contain the strength that they must provide to men”. Steiner passed away in May 1925 leaving these questions open. The forces bridging will, thought, and action are etheric. They are released from the food plant in digestion. The force that Steiner referred to is polar to the exacerbation of self-interest. It is the force of fraternity between bodies (will force). The fraternity between bodies is an impulse provided by Christ.

How to set up such food? First, we must consider: the fitness of the other nutritional systems (physical food digestion / breath and senses); the new forces that we can lead by consciously manipulating biodynamic preparations (500, 501) involving elementary beings, showing them the light of Christ in the interlacement of the food substance (photosynthesis); matter, form, and essence are inseparable; Christ is a solar being who can involve photosynthesis. It is in photosynthesis where we can insert in the food the ‘essence principle’ of fraternity between bodies from the Sun-Christ. The forces radiated by spraying preparations (500, 501) originate in the Sun. These preparations stimulate etheric forces. Each elementary being or living element (earth, water, air, light, and heat) is

associated with a physical element (N, P, K, water, CO₂, light, and heat). The result is live biomass (C₆H₁₂O₆ and essence).

How can such archetype fix in food? In photosynthesis, the elementary beings of heat interpolate the elementary beings of light, on the one pole, with the elementary beings of gas (CO₂), water (H₂O), and earth (N, P, K), of the other pole. Lucifer and Arhiman cast shadows on the elementary beings. They consciously prevent them from accessing the light of the Sun-Christ. Thus, the elementary beings cannot configure plant food by including the etheric forces of Christ. This requires the conscious intervention of man. But how can we provide a view of Christ’s “light” to the elementary beings in growing food plant? Through the elementary beings of heat that live in the warmth of the human blood. Communication can be established between heat beings from the human blood and heat beings in nature. The elementary beings of heat in nature are free from Lucifer and Arhiman. They are who make the interpolation between the elementary luciferic beings of light and the elementary ahrimanic beings of gas, liquid, and solid. The human organ that makes this communication possible is the heart. It is the human heart where the light of Christ lives in. In the process of giving dynamism to preparations 500 and 501 from the blood warmth of the heart of the element giving dynamism it is possible to cause the force of Christ to flow. In the biodynamic plant food so interwoven, the etheric force of Christ begins to live. An archetype from the Sun-Christ can be inserted in Bd Demeter food.

During seven years 30 – 50 tons per month of Demeter bananas were produced in a SFF project (2000 – 2012) and distributed to São Paulo etc. It is the love living in the hearts of SFF workers and their deep connection with Christ which makes such project possible. In these workers – very humble and poor and deeply connected with the earth – lives Christóforos, the bearer of Christ!

The method applied at San Francisco Farm (SFF) was (a) the spiritual fundamentals for agriculture prosper-

ity (Steiner, 1924) and (b) Proceedings in the Free Superior School of Spiritual Science (R. Steiner). The results were what we have done at SFF in practice: (a) the banana production (30-50tons/month), (b) the market conquered (40 supermarket stores only in São Paulo), (c) the Cassino Group championship product during 7 years, (d) the clients' fidelity conducting the market fidelity (better organoleptic attributes) and (e) better financial attributes conducting the market fidelity (better prices, supply regularity, humane commercial relationship etc.). San Francisco Farm results in practice and its gnosiology conception are the relevant scientific data.

SCIENTIFIC CONTRIBUTION

Breeding maize under biodynamic conditions for nutritional value and nutrient efficiency

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Research question

In the last century, Rudolf Steiner linked the application of mineral fertilizers to a gradual degeneration of food quality. In contrast to viewing crops as passive recipients of nutrients, he posited that plants have a kind of intelligence associated with finding nutrients and that exercising that capacity is important.

Since Steiner's time, application of mineral fertilizer has become the norm world-wide. Cereals have been bred and selected for their ability to respond to mineral nitrogen (N) fertilizer. However, N fertilizer causes the accumulation of cereal storage proteins that have low contents of essential amino acids thereby reducing nutritional value. Furthermore, N fertilizer pollutes of water and air. Therefore, our question is to explore how breeding and selection under low-mineral input, biodynamic conditions affects nutritional value, protein quality, and nutrient efficiency.

Research method

Since 1988 we bred and selected maize varieties for 44 growing seasons under low-input organic and biodynamic conditions, alternating summer and win-

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ter nursery crops in Wisconsin and in Puerto Rico. Maize was generally grown after grass or legume crops. Fertilization initially consisted in application of composted manure; biodynamic preparations were applied in Wisconsin. For the first 14 years, breeding consisted mainly in breeding open pollinated varieties. In 2002 an inbred and hybrid breeding program began with selection for high methionine content in grain, high general combining ability for yield, and nutrient efficiency under conditions where manure was either not applied or applied in low doses. Breeding lines were selected for per se and test-cross performance. A consortium of N₂ fixing (diazotrophic) bacteria was developed and applied to seed grown in nurseries. Selection criteria included robust top and root growth, grain yield, dry down, standing ability, competitiveness with weeds, N₂-fixation (isotopic natural abundance method), chlorophyll content of foliage, and grain protein and methionine in grain and per ha. Essential amino acids were determined by wet chemistry (HPLC), and near infrared spectroscopy.

Results

In 2004 we observed spontaneous appearance of opaque kernels in breeding families associated with elevated contents of methionine and lysine. This persisted in a variety of inbreds and families. The opaque

trait proved mostly to be heritable and stable, but not in all cases. Electrophoretic studies suggested that grain proteins had shifted away from alpha zeins to nutritionally more valuable beta and delta zeins and non-zein proteins.

In 2009 a set of exotic landraces was identified that appeared to be fixing N₂ and they were used for breeding new, N efficient inbreds.

Inbreds and hybrids were developed that exhibit competitive yields with normal cultivars but routinely produce ca. 30% more methionine and 16% more lysine and higher levels of protein production on sites where low rates of fertilizer are applied. The cultivars are more robust and productive under low N conditions and have higher contents of minerals in their seed. In part, this may be due to greater extraction of nutrients from the topsoil associated with greater root growth. However, some cultivars appear to utilize partnerships with diazotrophic bacteria to obtain more N.

Conclusion

The results validate a new, holistic breeding approach that simultaneously combines breeding for quality and for nutrient efficiency under biodynamic/organic conditions. Results are greater nutrient value of grain and greater nutrient efficiency for plants. The results

are due to the maize plant's response to humans changing their approach to fertilization, exercising classical breeding methods, and fostering beneficial plant/microbial partnerships. Wider-spread application of such methods and outcomes may be useful for fostering healthy crops, animals, people, and a healthier planet.

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SCIENTIFIC CONTRIBUTION

Droplet evaporation method as a potential tool for qualitative analysis of foods and agricultural products

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Background

During the evaporation of liquids, in course of an auto-organization process, complex structures may form. On such a phenomenon relies the droplet evap-

oration method (DEM). Here we present experiments regarding the application of DEM to quality analysis of (i) different wheat seed varieties [1, 2] and (ii) wines deriving from grapes cultivated under different cultivation regimes in a long-term experimentation trial [3].

Materials and methods

In (i) droplets of a leakage (prepared by placing wheat seeds into water for one hour) were evaporated on glass substrates under controlled conditions. The

dried residues were analyzed in dark field microscopy and photographed in magnification 100x. The polycrystalline structures in the images were evaluated by means of ImageJ for their local connected fractal dimension and fluctuating asymmetry. The DEM results were correlated with the seeds viability measured by means of a germination test. In (ii) droplets of wine were evaporated following the same procedure. The evaluation of the patterns consisted in the measurement of the field covered by structures. The results were compared with the results of the chemical analysis of wines.

Results

In case of both experimentations the different samples (in (i) different wheat varieties and seeds following a stress treatment; in (ii) biologic and biodynamic wines) could be significantly distinguished, moreover strong significant correlations could be found between the DEM data and other applied analysis. In (i) the fractal complexity of structures correlated positively with the seed viability; furthermore, the structures obtained from seeds characterized by a higher viability showed also a significantly more exact bilateral symmetry than those from low-quality or stressed seeds. In (ii) the DEM results correlated with the sugar and alcohol contents, dry matter, optical density at 520nm, and the total phenolic content of

the wines. The wines obtained from grapes cultivated under different regimes could be significantly distinguished basing on the results deriving from DEM (shape descriptors) but not basing on those deriving from the chemical analysis.

Conclusions

DEM represents a rather simple and time-saving analysis method. Out of our experiments it results that it is sensitive to quality differences due to cultivar characteristics and stress treatment (experiments i) as also different cultivation regime (experiments ii). Further experimentation is required to study DEM more in detail and be able to use fully its potential.

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SCIENTIFIC CONTRIBUTION

Biodynamic milk quality in Germany and human health

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A controversial debate concerning the differentiation of the product quality of organic res. biodynamic and conventional food can be found in literature. Unimpressed by this academic debate subjectively convinced consumers are increasingly buying organic produce. The assumption of a higher health value and a general higher product quality of organic food are reported by several surveys and identified as one of the main buying motives. However definition of organic food quality and methods to distinguish organic and conventional food quality are currently not existent

and organic and conventional foods are considered to be of equal health benefit. In regards to milk, first studies show differences in milk composition due to the production context. Those markers of differentiation of the fatty acids (FA) (n3, CLA and specific TFA) are supposed to have beneficial nutritional properties. Is it possible to differentiate organic res. biodynamic and conventional milk consistently? How does the intensification level in organic and conventional dairy systems impact on the product quality of milk? Does differentiating milk quality and different processing levels have any meaning for the health value of milk?

This presentation will discuss the main context and

especially implication for organic dairy production of the results of a PhD-project on the differentiation of organic res. biodynamic milk quality from low- and high-input systems and an evaluation of the digestibility of "Vorzugsmilch" in human children. The project included 1.) a literature review on organic food quality 2.) a system comparison and milk quality analysis of FA and antioxidants (AO) of 24 farms in southern Germany and 3.) an oral food challenge with children. (Kusche 2015)

Specific FA and AO marker differentiate origin and intensity of the milk composition in both seasons during summer and winter. Specific authentication criteria on the basis of certain marker compounds (FA, AO) were identified. A pilot study on the tolerance of milk from different origin and processing showed in a double blind oral food challenge that biodynamic "Vorzugsmilch" was tolerated by all children in contrast to conventional homogenized and pasteurized milk which led in most cases to allergic reactions. These results showed in general that lower intensified organic farms practicing access to pasture and grass-based feeding were able to produce milk with

a distinguishable product quality. Milk quality benefits from a lower intensification level in both the organic and the conventional system. The results address the potential to orient organic dairy production via low-input strategies towards an "authentic" and distinguishable organic product quality. The food challenge results of a better digestibility may also provide first insights into the potential of low-processed milk and milk-products. The differentiating marker and also their nutritional relevance point on an interesting unique selling proposition of organic milk, which may fulfill the demands of health-conscious consumers of organic foods and help to generate higher milk prices of organic res. biodynamic milk.

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OBSERVATION REPORT

The Turnaround in Nutrition

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In 1921 Ita Wegman, the doctor who developed anthroposophical medicine with Rudolf Steiner, founded the first anthroposophical hospital in Switzerland. She began to use mistletoe for cancer patients. Some years later, a specialized hospital for anthroposophical cancer treatment using mistletoe and a holistic therapeutical approach was built up. In this hospital nutrition played a key role. The kitchen hospital's chef accompanied the patients with training and advice. The first task he gave them was to answer three questions: What do you eat? How does it taste? How do you digest and tolerate what you have eaten? He experienced that this was the first step for the patients on the way to become healthy (Spindler 2018). This "mindful eating" is also used as a sustainable way to reduce weight in obesity programmes (Melchart

2017). It enables one to perceive different food and tastes and how they are tolerated by the organism. The effect is an enhanced feeling of self-connectedness. This means that you listen to your inner signals which in turn tell you what is good for you to eat – because what tastes good and what is pleasant can be digested and tolerated (Frankenbach 2014).

Considering that 40 million people are killed each year by non-communicable, nutrition related diseases (e.g. diabetes, cardiovascular diseases etc., WHO 2017) this approach seems worth practising. In addition, one third of the world's population suffers from malnutrition, which can either be too little or too much food. This leads to either underweight and hunger or overweight and obesity. Taking into account that so many people are concerned with nutrition it is obvious that this is a remarkable economic factor. So the food industry steps in and defines food quality and

what is healthy nutrition. We are tempted to pass the responsibility for a healthy development of our body, soul and spirit to industry.

In our society daily nutrition is characterised by many new, steadily changing dietary trends such as clean eating, which means choosing unprocessed, freshly cooked food without additives, colours and aromas. Vegan diet has become very well-known and many new products such as, for example, lentil noodles and almond drinks can be purchased. To buy ethically justifiable food is discussed in journals and street food has become common. A diet free from gluten, salt or dairy is often more a means to express one's own individuality than a real medicinal concern (Ellrott 2012, 2016). Allergies and intolerances tell more about the fear of the food than of intolerable constituents or the quality of the food. At the same time new products are introduced at short intervals such as green smoothies, edible insects or black sandwiches. Insects are advertised as an environmentally friendly and climate neutrally produced source of protein. The question is whether superfoods like Chia, Goji, Matcha, Moringa are really 'super'. An investigation on Goji berries showed that the claimed effects cannot be proven (Goerg 2017). With so many new diets and products the confusion increases on what is really needed and what is healthy and good food. This lack of orientation leads to uncertainty. As a consequence, scientific comments and advice on food as well as recipes are invited. Consumers believe more in advertising than in themselves. This is a sign that our society really needs an own, inner judge and creativity for realising the daily diet. How can this inner judge be developed?

Albert Einstein, the famous physicist, says: "The significant problems we have cannot be solved at the same level of thinking with which we created them."

That means we need a turnaround in nutrition. This turnaround begins with the three questions as a means to develop the sense to know what is needed and what is good or not good for us. This is an easy way for everyone to start with the turnaround and to start with being independent of the food industry. Subsequently conscious living is realised because it is the individual who decides on his own values, and it is up to the individual to take care on what to eat and what to do out of a mindful attitude. Thus an inner certainty of what the need is and what the own values are is built up and leads to self-connectedness. The

individual is the sculptor of his own life, his diet and as consequence of the environment he lives in. Because through what the consumer buys and eats he shapes the world. The consumer is the co-producer and he decides at the cash desk how the world looks like.

The implications of applying the three questions as a first step to healthy diet and a healthy life are that perceiving food really consciously leads to an interest in where it comes from and how the biography of it looks like. In concrete terms it means that we want to meet food, meeting not only consuming food because we eat food, not nutrients. Thus connections that are urgently needed are realized and the consumers start being co-producers. The mindful attitude leads in addition to a better appreciation of the food chain elements and to humanity in economics. Economy should be driven by understanding and brotherhood not by egoism and profit maximization. Consumers are no longer the victims of the food industry but are taking responsibility for their own diet, for the environment and thus contribute to a healthy world by a healthy, sensually pleasant, sustainable diet consumed with mindfulness (von Koerber and Bader 2016).

This is the approach of salutogenesis that Antonovsky already introduced in the 1970s. It means that we look at what keeps us healthy and that we feel coherence as a source of health. That leads to an understanding of the connections and relations in life, to a conviction to be able to design the own life and to the belief in the sense of life. This attitude is also named as resilience, to be able to deal with what comes towards us and not becoming ill from it.

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Egg quality – differences between biodynamic, organic and conventional samples, measured with Fluorescence Excitation Spectroscopy (FES).

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It was in question, if there is a holistic quality parameter, which could reflect the special quality of eggs from biodynamic farms. We used delayed luminescence of the egg yolk, measured with FES, to show differences between eggs from biodynamic, organic and conventional origin.

A total of 98 egg samples from retail markets were investigated (54 of them labeled "organic"). Differences in delayed emission of the samples in relation to their origin was observed, and a differentiation between organic and conventional samples was possible for 86% of the samples from the retail markets, when using the FES-parameter R80ye/bl. The parameter R40w resulted only in 74% correct classifications, thus classification was improved by using the FES-parameter R80ye/bl. Especially organic eggs were misclas-

sified frequently, indicating that organic egg qualities were often times comparable to conventional ones.

For the 8 biodynamic samples among the organic ones, rather high emission intensities were found, they were all classified as organic.

On the basis of the known relations between the eggs emission and the feeding and housing of the hens, it can be supposed, that the biodynamic hens were kept under conditions appropriate to the animals demands, implying high welfare standards and fresh, green grass. On the other side, organic samples with low emission intensities can be supposed to originate from farms with low animal welfare standards.

Some examples will be presented to demonstrate the relation between feeding, housing and delayed luminescence, indicating farming practices worthy for attaining high quality eggs.

Fluorescence Excitation Spectroscopy – fundamental principles and key-phenomena of delayed luminescence. An introduction to the method.

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Photon emission of living organisms is observed in a wide field of scientific disciplines (van Wijk 2014), the first measurements in this area were done by Gurwitsch (1920) by using roots as detectors. Measurements of delayed luminescence (induced emission) with photomultipliers became public by research from Ruth and Popp (1976) and Ruth (1977) who wanted to make apparent special quality aspects of foods. Actually, a differentiation of milk samples from biodynamic, organic and conventional farms was possible by FES.

The method used for measuring delayed luminescence at KWALIS is based on the principle of ultra-low

emission of photons of a sample after illumination (excitation). The FES measurement apparatus (described by Strube & Stolz 2010) is able to illuminate a sample with light of different colors (wavelengths), and to detect delayed emitted light by counting emitted photons at 100 consecutive time intervals. This declining emission curve is used for evaluating quality aspects of the sample.

Different phenomena were investigated, observing changes in emission, dependent on excitation color. On the basis of many observations, some ideas appeared on how to interpret the results, which often times were in relation to the actual physiology, to growing conditions or to processing. Key-phenomena are presented from samples like aged tomato puree,

ripening of apples, cereal from biodynamic, organic and conventional origin, or bean seeds grown under different farming conditions. Differences between organic and biodynamic samples were observed e.g. in calendula seeds, in eggs and in milk samples. By looking on these phenomena, an impression may arise of the quality aspect which is presented by the measured photon emission.

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SCIENTIFIC CONTRIBUTION

How could we show the effect that farming methods have on the quality and vitality of the products?

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I am undertaking a research project as part of a Master's degree on Researching Holistic Approaches to Agroecology. The work is still in progress.

Hypothesis

It has been shown that there is a tendency for agricultural methods to potentially affect the quality and vitality of the produce within defined parameters. My hypothesis is this should be able to be demonstrated in an integrated way that would make sense for the consumer.

Methodology

This will be a combination of qualitative and quantitative approaches. Qualitative approaches will include the meaning of terms such as quality and vitality as used by food producers and, in the first phase, the use of round picture chromatography.

The quantitative aspects of the study will include already published data (secondary research) on the absence of particular unwanted components such as pesticide, herbicide, fungicide residues as well as possibly GMOs and heavy metal residues.

The presentation at the research conference gives

an overview of the project. Note: The Researching Holistic Approaches to Agroecology Course is delivered by Crossfields Institute (UK) in cooperation with the Alanus University Institute for Philosophy and Aesthetics.

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The organic-farm-effect –allergy preventive measures in the context of organic agriculture in early childhood years

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Core principles of organic farming according to the IFOAM are health, ecology, fairness and care. Especially an assumed higher health value of organic food can be identified as one of the main buying motives for consumers. Additionally indications for nutritional benefits of organic res. biodynamic milk can be found in literature. Dairy production is an integral part especially for biodynamic agriculture. For biodynamic milk the processing as well as the keeping and feeding of dairy cows are regulated (f.i. hay feeding, no homogenization or ultra-pasteurization of milk) while in organic agriculture only the requirements of outdoor access and pasture are currently addressed.

We evaluated the farm effect and the consumption of organic milk before the background of the principle health. Literature from different disciplines was reviewed and an expert interview with Prof. v. Mutius (LMU Munich, Germany) was done. Findings will be discussed in their potential and actuality for organic and biodynamic agriculture. The hygiene hypothesis (Strachan) showed that less children and higher hygiene standards in families nowadays led to lower infection rate, which meant a higher prevalence of atopic disorders, pointing on the effect of hygiene in allergy prevention. The farm effect (Braun-Fahrlander and v. Mutius) showed that the exposure of children in early childhood to a farming environment could prevent allergic disorders. Factors of this farming environment meant contact of children to animals and stables as well as the raw- and farmmilk consumption (Loss et al 2015). In general a traditional lifestyle benefits allergy prevention (f.i. Waldorf-school families, amish people, farming background). Organic milk showed consistent differences to conventional milk in its composition (Srdnicka-Tobler et al. 2016). Consistent differences can be found also for biodynamic milk as well as within organic production in high- and low input systems (Kusche 2016). Biodynamic low input dairy farms showed the highest quality potential of

milk in terms of fatty acid composition, pointing on the importance of grass fed dairy production and pasturing. The consumption of organic milk was associated to a lower risk of eczema and allergic sensitization in children (KOALA study, a.o. Kummeling et al. 2008). Additionally oral provocation testings with children with food allergies showed a remarkable tolerance of biodynamic raw-milk (Vorzugsmilch) (Kusche 2016). Both factors the organic low- input production and the low-processing (no pasteurization and no homogenization) seem to be of high importance for a high tolerance and possible health effects of milk.

Further research in this matter is needed. The combination of both factors: 1.) milk production under organic res. biodynamic requirements and the specific context of those farms (pasturing etc.) and 2.) the low-processing (no pasteurization etc.) of milk and milk products is referred by us as ORGANIC FARM EFFECT. This combination seems to incorporate specific benefits in allergy prevention. Meaningful preventive measures can be developed before this background to bring children in contact with those beneficial factors of organic farms, organic food and milk and milk products from early childhood on. Examples are farm kindergartens, farm visits and food degustations, many of such ideas are already existent. This could bring children in a lifestyle, regional and environmental context in which preventive factors are present. This farm-based concept has also to be seen as an alternative for industrial products in the making to incorporate the farm effect in a "tetrapak" or "pill". Besides prevention this approach incorporates several positive side-effects like the promotion of regional production, contact of city and farm and added value on the farms in general. The fulfillment of the IFOAM principle to promote health and the goal of biodynamic agriculture to produce high quality food for human development can be further strengthened within this proposed preventive concept.

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POSTER SESSION

OBSERVATION REPORT

The Importance of Home Economics and Sustainable Cooking as a Subject in all Schools!

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Practical and theoretical home economics based on the ideas and ideals of anthroposophical nutrition is of significant relevance as a subject in every contemporary educational system and school model. I am convinced that these concepts and principles are not only cutting edge, but also not exclusive and therefore without a doubt befitting of every socially, environmentally and ethically conscious form of education.

Because the free market and within it, the food industry, focus inherently on their own continuous growth and the profit margins of their stockholders; and not on the health and well-being of consumers, the environment or the citizens of this planet, it becomes essential that all schools whether privately or state-run take on this significant responsibility. Home economics as a subject provides the optimal framework, offering a wide range of content and methodology to achieve the educational goals that help in forming the politically mature citizens imperative for building and maintaining a healthy social democracy.

Teaching home economics with practical and theoretical cooking and nutrition offers very straightforward solutions. The students begin to learn about and make a vital connection between nature, animals, the earth

and soil, the air and the climate, water and our food. They learn to recognise that the sustainability of humanity depends immanently on the sustainability of our planet. That the everyday choices they make, what they do and how they live have an impact on humanity and the planet at large. We can guide them to see that it is possible to be aware of their impact and the physical and ethical impact of our society; and how they can reduce their personal impact or „footprint“ in a responsible way as they go through life, strengthening a sustainable planet for all. We can empower the students with knowledge, showing them that this is their business and they are important. Instilling in them a sense of hopefulness in a time when it seems the individual has little or no power to change what is. In doing these things we awaken an interest through knowledge that will create the ability and desire to form new and individual questions of importance, in their lives and for the future.

The goal of Waldorf education is teaching children to maintain and strengthen their life forces in a way that enables them to grow and develop into mentally and physically healthy free-thinking individuals with the best prerequisites possible to live out their highest potential in an effective and fulfilling manner for both themselves and the world. Unique to the Waldorf educational philosophy, and a basic concept behind

addressing this lofty afore mentioned goal, is the premise of addressing and teaching to the three-fold nature of humankind. Seeing the individual as a threefold being requires acknowledging the spirit and soul bodies as well as the physical body. The spirit is directly related and intertwined with the sensory and nervous systems, as well as to our mind and thinking. The soul body is in the same manner directly connected to the organs, respiratory and blood systems, as well as our feeling and emotional life. Lastly the physical body is directly related to our limbs, as well as our will forces. Cooking and nutrition as a lesson actively addresses the aforementioned when preparing, enjoying and reflecting delicious quality meals.

POSTER SESSION
SCIENTIFIC CONTRIBUTION

Nitrogen efficiency in organic winter wheat breeding

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In organic agriculture, nitrogen (N), which is important for yield and quality performance, is only available in limited quantities. An increase of 1% of protein "costs" approx. 5-7% of yield. All indirect laboratory methods to predict baking quality are strongly linked to the protein content with low correlation to the effective baking quality. According to Knapp et al. 2012 in organic agricultural systems protein- and baking quality are correlated with 25-60% but not as strong as in conventional agriculture. However, a protein content payment system was introduced in 2016 by the cereal industry association swiss granum. Payment system is based on bonus (> 13%) and malus payment (< 12%).

Two studies about nitrogen efficiency were performed at Getreidezüchtung Peter Kunz (GZPK). GZPK is a non-profit organization active in biodynamic plant breeding for more than 30 years. Two bachelor theses were carried out in collaboration with HAFL (School of Agricultural, Forest and Food Sciences).

The aim of the first Bachelor's thesis was to examine the main traits for "Ideotypes of organic wheat"

The paper covers in detail the concept of home economics in classes 7 and 8 as I conceived and taught it for 13 years in the Integrative Waldorfschule Emmendingen. It describes both the practical cooking lessons as well as the theoretical weekly subject lesson „Nutrition, Humankind and the Environment“. The paper was written in 2013 as a required final paper for the one year further education study program in anthroposophical nutrition at the „Arbeitskreis für Ernährungsforschung“ in Bad Vilbel.

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(Lemerle et al. 1996, Gooding et al. 1993, Osman et al. 2012) of Swiss organic wheat varieties.

The main traits were (a) straw yield and (b) recovery of nitrogen. Data collection was carried out for 8 breeding lines at three locations with different soil characteristics for soil canopy cover, plant length, straw yield and straw nitrogen content. Nitrogen recovery was determined by calculation of N-harvest index (HI = N-Grain/N-uptake).

Soil cover, plant length and straw yield had a significantly positive influence on grain yield. Thereby soil cover and straw yield was moderately correlated ($r=0.51$, resp. $r=0.36$) whereas plant length was marginally correlated ($r=0.17$). Increasing nutrient availability resulted in higher straw N content and grain yield, while N-harvest index tended to decrease. To sum up, the thesis indicates that phenotypic traits (soil cover, plant length, straw yield) can be an effective selection criterion.

The second thesis' aim was to investigate the relationship of baking quality and protein content respectively protein quality. Baking quality is a complex trait, which is generally estimated by a set of indirect parameters (e.g. protein content, Zeleny sedimen-

tation value, farinogram, gluten content). A set of 8 breeding lines and 4 reference varieties were tested over 2 years (2015/2016) at three locations. To test the effective baking quality a Mini-Baking test (MBV) developed by GZPK was performed. This method allows tests with small samples of 25g flour per bun. Bread buns were then analysed for volume and shape parameters (form and stand). Based on the VS Index (shape index x bread volume) the effective baking quality was tested.

The VS Index is only partially related to protein content (2015 $r=0.27$, 2016 $r=0.22$). However, protein content is correlated with the following indirect parameters: Sedimentation value ($r=0.69$, 2015), water absorption ($r=0.89$ and $r=0.78$ in 2015 and 2016 respectively) and bread volume/100 g flour ($r=0.64$, 2015). Furthermore, estimation of protein quality (determined by Zeleny sedimentation value) had a significantly positive influence on bun volume (volume/100 g flour) in 2015 ($r=0.63$) and the VS index) of bread buns in 2015 ($r=0.6$).

These results indicate that protein quality (determined by Zeleny sedimentation value) have a higher impact on effective bread baking quality than protein content.

POSTER SESSION
OBSERVATION REPORT

Safe Food from Contaminated Soil? Biodynamic Agricultural Method shows successful Field Research

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Many farmers and consumers are unaware that persistent organochlorine pesticides (POPs), such as DDT, are active in our soils and still a health issue many years after their sale in the United States was banned. The situation remains critical because most agricultural ground has been exposed to POPs at some time, cropping and treatment histories are notoriously inaccurate, and there is a long breakdown time for toxins in untreated soil – about eighty years for DDT.

So, the Mini-Baking-Test may be an appropriate methodology to identify effective baking-quality in early breeding lines. In context with the negative correlation of yield and protein content, it allows to detect N-efficient lines with slightly higher yields and equal baking quality as standard varieties. By this means efficiency of resources can be guaranteed from the beginning of the supply chain.

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Because of the damaging effects hidden pesticides can have on humans and the environment, it is important to address this serious challenge. Today, DDT and its metabolites are still found in virtually every breast milk sample tested. Cancer, decreased fertility, stillbirths, neurological abnormalities, liver damage, and impaired immune function are all linked to DDT. A safe, sustainable, inexpensive, and effective method is needed to (1) reduce pesticide concentration in soils, and (2) help prevent pesticide uptake in crops. The following results of a one-year study indicate that the biodynamic method meets all of these criteria.

Soil tests on my farm in Hawaii in 1999 indicated

high levels of DDT contamination. I set up a duplicable field study to investigate pesticide exchange between soil and food, in particular beets (which take up pesticides readily) and green beans (which take up pesticides less readily). After a year of field research (2005–2006), the measured results showed that the biodynamic agricultural method of Rudolf Steiner successfully reduced both pesticide accumulation in beets and persistent pesticide concentration in the soil more than other agricultural methods that were used. None of the beans showed detectable DDT uptake.

The research design consisted of a field test of 16 identical 10' x 10' plots set up with four different agricultural treatments and four replicates of each treatment. The treatments were: Biodynamics, Biodynamics plus High-Lignin Compost, High-Lignin Compost, and Control.

The test study results are encouraging for those who plan to use biodynamics, whether to remediate soil or provide safe, nutritious food. All four replicate groups demonstrated reduced pesticide concentrations in the soil. All treatments also showed pesticide accumulation in the beets. The average reduction of

pesticides in the soil was as follows: Biodynamics 81%; Biodynamics/Lignin 72%; High Lignin Compost 57%; and Control 53%. The average uptake of DDT in the beets was as follows: Biodynamics 0.0002 ppm; Biodynamics/Lignin 0.001 ppm; High Lignin Compost 0.002 ppm; and Control 0.004 ppm. These outstanding conclusions match other reports suggesting that the biodynamic method of Rudolf Steiner can reduce if not eliminate the harmful effects of pesticides within several years.

Although a small experiment, the preliminary study showed results that are likely to be of great interest to farmers, researchers, and consumers. It follows that the biodynamic method of agriculture could be effective in other soil remediation challenges as well. The need to resolve the hazards of soil pollution is now. At an annual materials cost of approximately \$60 per acre (spring and fall application of preparations), biodynamics is indeed an inexpensive, safe, sustainable, and effective method of restoring vitality and life to our soils and our food.

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THE ROLE OF ANIMALS IN BIODYNAMIC AGRICULTURE

SCIENTIFIC CONTRIBUTION

Our pig – an alternative breed of pigs

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Aim of the project

The aim of the project is to develop a new breed of pig that should be resistant and well adapted to outdoor conditions. Sows should have good maternal characteristics and the pigs should be able to be fed with products which are not suitable for human consumption. The pig breed should be an alternative to the intensive breeds and still remain economical. The new pig breed should give the producers the choice to keep an alternative pig breed which is at the moment not available in Switzerland.

Research method(s)

The breed is represented by a rotational crossbreed of six breeds over ten years. The crossed breeds are Schwäbisch Hällisches Landschwein, Bunte Bentheimer, Turopolje, Edelschwein, Duroc and an own breed of Demeter farm, called Buntess Distelschwein.

It is a small project conducted by farms producing under organic or bio-dynamic standards. The following data is collected in the experiment:

- Weight gain per day (The animals are weighed four times until slaughter)
- Health of the claws and suitability for outdoor terrain (angle)
- meat quality (lean meat ratio, back fat)
- Number of piglets per litter
- Number of litters per sow
- Diseases (severity, duration, treatment)

Results

The breeding work started at the beginning of 2018. The first piglets are expected to be born at the end of May. We can already present some data on the conference. At this stage, the advantages and disadvantages of the free-range husbandry can also be discussed.

Conclusion

The project is still in an early stage. It will not be possible to make conclusions from the project at the time of the conference. But the topic is of great importance for small, extensive farms and offers new management possibilities.

SCIENTIFIC CONTRIBUTION

Ethical considerations of consumers concerning the alternative system of mother/dam-bonded calf rearing in German dairy production

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Broad criticism on animal welfare can be found in the media and society in Germany during the last

years. Recently the early separation of calf and cow in dairy production came into focus. In agricultural practice several farms, mostly biodynamic res. organic, established an alternative system, the dam rearing

system. Could this alternative approach been further established in dairy production- through support of the consumers based on their ethical considerations and awareness?

Consumer questionnaires were distributed on 4 dairy farms practicing in Baden-Wuerttemberg, 3 of them were certified biodynamic, 1 was a certified organic farm. The standardized, written questionnaire was handed out to the customers of these farms in the shop or the market stand and was quantitatively evaluated. By means of questions concerning the buying behavior, demographic allegation as well as the state of knowledge regarding this subject, a profile of the customers was generated and then related to their approach to the dam rearing system. This approach was quantified by twelve items of animal welfare concerning four themes: the emotional life of cow and calf, the health and behavior of cow and calf, the personal responsibility of the customer and the practicability of dam rearing systems.

The high return rate of 39 % (n=78) and the homogeneous answering structure show the high interest

of consumers on the topic. Most consumers prefer calf and mother to stay together for a longer period of time. Even though this consumer group is very specific (principally high educated, female customers) and sensitized already buying milk on those direct selling dairy farms, it could be possible to broaden the awareness on alternative systems as the dam rearing system on the consumer side. The homogeneous answering structure reflects the high social acceptance of the dam rearing system as well as the desire for changing conditions within the dairy farming.

Similarly, the reply of the qualitative question indicates, that the issue of the early separation of cow and calf has a strong emotional connotation. Several studies regarding the public assessment of animal welfare demonstrated, that the personal, sensory experience is the determining factor for a nuanced formation of opinion. Both aspects could make it possible to establish the dam rearing system on direct-marketing, biodynamic farms with a conscious clientele. How far this may be the case for farms without contact to the customers or even retail, further research is required.

SCIENTIFIC CONTRIBUTION

Investigation of the internal atmosphere of hives of different typologies hosting colonies of European domestic bees (*Apis mellifera L.*, *ligustica* breed, *carnica*, or their hybrids)

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This research project will study new housing solutions for the bee organism that can facilitate and not counteract the metabolic processes and the various biological mechanisms put in place by it. In addition these new housing solutions along with the metabolic processes may reduce the varroa mite (*Varroa destructor*) infestation that, together with other important pathological and environmental factors, affects the life of the bees. Animal health is ensured by a correct relationship between metabolism and internal homeostasis by the polarity of the follow-

ing two actions: transformation and maintenance. According to Rudolf Steiner (1923), a symptom to assess this state of health is given by the constant relationship over time: pH gastric juice/pH blood juice at optimal values. In the laboratory, Kozak and Currie experimentally tested a group of approx. 300 worker bees that reached a CO₂ concentration of 2.13%, with a temperature of 25°C in a relatively low ventilation of the environment (14 l/h), resulting in the death of Varroa mite equal to 46.12%. Certainly a "field" experimentation with temperatures in the hive closer to the normal range (35 – 36°C) would have given more significant results and would have been adherent to real conditions, but in any case, this result is eloquent. The bee family maintains a homeostat-

ic environment within the hive, resulting in high air temperatures and CO₂ concentration values. The CO₂ deriving from the family becomes "light" due to the high temperature of the air and tends to rise and not to go down to the bottom of the hive, escaping via the opening that is located there. Can a hive full of edges, with large external surfaces, and improperly localized openings guarantee family homeostasis in terms of temperature and CO₂ concentration? O₂ and CO₂ are a necessary polarity in life. As soon as CO₂ enters the biological solvent "water" it becomes a weak acid where relatively few protons (H⁺) and bicarbonate anions (HCO₃⁻) are dissociated. This weak acid forms, in the hemolymph of the bee, a buffer solution character which tends to keep its pH value constant. In the cells of the inner lumen of the gastric tube there are cell membranes of the anionic transport enzymatic systems that withdraw from the bicarbonate anion lumen to replace them with chlorine anions: here the weak acid is transformed into a strong acid capable of transforming food. It is therefore CO₂ that could be important to maintain the polarity mentioned earlier which results from a well-defined relationship of pH gastric juice/pH blood juice.

Phase 1 of the project consists of a quantitative survey of the concentration of CO₂ inside the hive in the area of the combs. These investigations are preceded by a phase of observation of the beehive and of the family according to the principles of scientific-spiritual

investigation. Together with the detection of internal CO₂ concentration, we expected to record data on the internal temperature of the hives (different positions) and external environment. The humidity of the external environment has also been detected and, in some cases, also the percentage of relative humidity inside the hives (different positions) In this first phase of the investigation we want to know whether the hive organism, under certain conditions, is able to develop and accumulate heat and CO₂ in a significant degree and in interesting positions. In Phase 2 of the project the hives that have the best homeostatic characteristics, are subjected to a comparative analysis with more systematic and in-depth measurements of T° and CO₂ concentration in the air of the honeycomb area. In Phase 3 we proceed to the design and construction of some new housing solutions. The observations and surveys have confirmed substantial and very interesting differences both in terms of T° as well as CO₂ concentration. We want to share these results to create a common base for everyone to continue to study and work for bees safety.

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SCIENTIFIC CONTRIBUTION

Breeding program for organic dairy cattle in the Netherlands

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Organic breeding is not yet well established in legislation, most organic dairy farmers use conventional breeding stock, although breeding goals and reproduction techniques used in conventional breeding are not in line with organic principles. Therefore Bio-KI started an organic dairy breeding programme and has so far sold 8000 doses of semen to dairy farmers in the Netherlands. The first five bulls did got 449 daughters milking at organic farms and breeding val-

ues were estimated by the Dutch Herdbook Organisation. This is the first initiative in the world to set up an organic breeding programme. However, while preliminary research showed that farmers do support organic breeding, sales of semen are still very low. This is mainly because the selection of bulls is too small and farmers have longstanding relationships with national breeding cooperatives or companies. Bio-KI must explore ways of increasing its market. The rise of new GMO technologies, gene editing in animal breeding on conventional farming might incline organic farmers towards more organic breeding.

SCIENTIFIC CONTRIBUTION

Organic Breeding of Laying Hens, the Vredelinger

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The organic poultry sector is entirely depending on conventional breeding companies for breeding stock. The multinational breeding companies are not equipped to set up small breeding schemes for organic production only. In 2009 we therefore launched a breeding project with hybrids aimed at developing a new breed. Result show a new breed, the Vredelinger, black and white feathers (Sussex like), 2145g body

weight, a laying percentage of 72% and light brown eggs of 58-60 g average. Cockerels grow to 1,2 kg slaughtered weight in 16-18 weeks. The breeding is based on kinship breeding and the focus is now on building up breeding groups in different urban areas and selling meat and eggs as niche products and premium prices. Later on the goal is to sell the new breed to larger scale farms to. Selection on performance is important. The breeding of such a new dual purpose breed can become a solution for the killing of too many one-day-old cockerels.

SCIENTIFIC CONTRIBUTION

How does a honeybee colony learn to cope with the Varroa mite?

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Abstract

Since the eighties of the last century the Varroa mite has become a major threat to the honeybee and must be controlled by regular application of organic acids even by biodynamic beekeepers. However, in a number of regions in Europe colonies have developed resistance against or tolerance for the mite. Some of the mechanisms studied have a genetic basis. Since experimental colonies with resistant queens and non-resistant worker bees fail to cope with the mite it is likely that inheritance is a necessary but not sufficient prerequisite. Two hypotheses to understand what happens can be tested. First, the colonies that co-exist with the mite have originated from locally adapted ancestors. Since adaptation indeed improves the bee vitality the Varroa tolerance/resistance (VT/R) trait could be the result of such an adaptation process. Second, VT/R behaviour is not innate but must be acquired. With the advent of epigenetics inheritance, the transmission of acquired traits from one generation to the next is a plausible mechanism. In addition, a different VT/R behaviour can be envisaged.

Transmission of the VT/R trait by imitation could be a possibility. Here, younger sisters in a colony would copy the behaviour from the older ones – as a kind of learning process.

Set up

To test the adaptation hypothesis colonies with VT/R queens and VT/R bees (test) and VT/R queens and non-VT/R bees (control), respectively, will be observed in the region where the behaviour has been developed. Without treatment against Varroa both groups of colonies are expected exhibit VT/R traits.

Transmission hypothesis: In a new unknown location test and control colonies will be established. As above, there will be no application of organic acids. Here, colonies with a VT/R queen and VT/R bees are expected to manifest co-existence and thus survival with the mite. Colonies established with non-VT/R bees are likely to fail.

A beekeeper in CH who has not treated his colonies against the mite for more than ten years will provide queens and 5'000 worker bees for each test group. The control group will be built with worker bees from non-VT/R colonies.

Parameters and analysis

The following data will be documented:

- colony survival.
- Number and size of the colonies in early spring and late fall.
- Weekly counts of the mites.
- Artificial infestation of brood cells with single mites, assessment of the number of offspring. Determination of the reproduction success (fecundity and fertility).
- Analysis of the variety and prevalence of different bee viruses in early spring and late fall.
- Assessment of colony population parameters: the number of worker bees, drones, open and covered brood in early spring, summer solstice and late fall.

Impacts of the project

All the data will be subjected to statistical analysis. In case of a clear distinction between test and control groups the impact of the project would be groundbreaking. First, we should be able to discriminate the role of adaptation vs. the significance of transmission by learning. If adaptation is prerequisite for VT/R, then artificial queen breeding – the regular procedure for colony reproduction – would be on trial.

Should the transfer of traits on the colony level be the case the implications for both breeding and apiculture would be far reaching. From a broader perspective the project would add a robust argument for the case of non-genetic transmission of acquired traits – and thus for the role of the organism (colony) as a whole.

SCIENTIFIC CONTRIBUTION

Steps towards appropriate feeding and farming conditions for dairy cows (Wiederkäuergerichte Milchviehhaltung): Milk quality, measured by Fluorescence Excitation Spectroscopy.

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To investigate factors influencing milk quality measured by delayed luminescence using Fluorescence Excitation Spectroscopy, several milk samples were analysed, with the focus on a) showing differences between sample qualities and b) finding factors affecting these differences. In a last step, important conditions influencing the milk quality were summarized, pointing on the demands of the cows regarding feeding, handling and housing conditions.

To examine differences in milk quality, samples expressing as many differences in production parameters as possible were chosen. Representative samples from five biodynamic farms (feeding hay in winter), five organic farms (feeding mainly clover-grass-silage added by corn-silage), and from five conventional farms (feeding grass- and corn-silage, added by cereals and industrial by-products) were investigated.

Samples were collected each second month (six times a year), on each farm. Housing conditions differed according to farming type, milk yield was a parameter well suitable to differentiate the farming types, and fatty acids of the milk samples represented the rations of the cows, implying winter-summer-changes according to available green forage. Results of the Fluorescence Excitation Spectroscopy showed rather no seasonal variations, but farm-specific constant emission values were observed, and differences between farming types were found for several FES-parameters, e.g. Mw1lr, Mw1ye, R40ye and Mw10/R40lr.

Influencing factors on FES-results were investigated. On single farms, variations in the energy supply of the cows occurred, which were reflected in the rations and the fatty acids of the milk. Correlations with FES-results were found for the FES-parameter R40ye on three farms. Another influencing factor was

the low supply of the cows with crude fiber, resulting in SARA (subacute rumen acidosis), which was reflected also in the milk fatty acids. The FES-parameter Mw1ye showed a relation to this fatty acids for three farms with variations in crude fiber content of the ration. Management factors also seemed to play a role for the FES-results, although correlations were rather weak.

The different milk qualities of the farming types may be evaluated by transferring the farm-internal observed effects to the total of samples. High values for Mw1ye, as observed in conventional samples, may reflect low crude fiber content in the rations, or the tendency to SARA. High values for the FES-parameter R40ye, as observed often times for samples from organic, silage feeding farms, may represent a neg-

ative energy balance. Low emission intensities are supposed to represent milk of high quality, originating from dual-purpose cows fed hay or pasture.

Further research is needed to estimate influences of rations (energy supply and crude fiber content) or housing and handling conditions on the basis of experimental research.

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Jenifer Wohlers & Peter Stolz (2019) Differentiation between milk from low-input biodynamic, intermediate-input organic and high-input conventional farming systems using fluorescence excitation spectroscopy (FES) and fatty acids, *Biological Agriculture & Horticulture*, DOI: 10.1080/01448765.2019.1580615

SCIENTIFIC CONTRIBUTION

Use and efficacy of homeopathy in prevention and treatment of bovine mastitis

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Homeopathic remedies are often used in livestock, their effect is discussed controversially. In dairy farming, bovine mastitis whose antibiotic therapy is seen as increasingly critical, represents an economic, ecological and health problem. In organic farming, the use of antibiotics is restricted by legal requirements; therefore the use of complementary medicine is supported. Because of this, homeopathy is mainly used by ecological and biodynamic farmers in animal husbandry in a holistic or anthroposophic sense. In science, the effectiveness of this complementary medical method is a contentious issue. The current state of research indicates inconsistent results. An analysis of peer-reviewed publications shows a homeopathic effect in dairy cattle in nine studies compared to ten trials without an effect.

In order to determine the effect of a homeopathic treatment in the case of bovine mastitis, research articles published to date (February 2018) have been evaluated including peer-reviewed and non-peer-reviewed publications in German and English language.

A total of 67 scientific publications were identified. After applying the inclusion and exclusion criteria, 32 studies could be used for evaluation. Assessment criteria and a rating score of 0 to 5 points were fixed for the appraisal. Healing and prophylaxis of mastitis were the main focus to highlight the medication success and its framework for suitable mastitis therapy. The success of healing and prevention were presented in opposite ways by the proportion of cured animals or number of incidence. For this reason, the assessment criteria were divided into the self-healing ability, the healing ratio of the trial groups and their percentage difference to each other and the cure rate in the verum group for the treatment success. The success of prevention was described by the mastitis rate and the mastitis ratio of the test groups and their percentage difference to each other. The top eight studies of this quality ranking were subjected to differentiated evaluation.

An effect in the prophylactic and therapeutic application of homeopathy was recognizable, no specific medication could be recommended. The medication should be based on the animal-specific, clinical symptoms and on the indications of the individual remedies.

The extent of the achieved effect was determined by the choice of remedy, the pathogen, the study conditions and the individual conditions of the farm. It was possible to reduce the antibiotic use by up to 75%. Some studies indicated that homeopathy might have a positive long-term effect. Therefore, its preventive use could help to stabilize animal health. The criticism of homeopathy as a placebo effect could be refuted by the results of these studies. Furthermore, the results suggested a high self-healing ability in bovine mastitis, whereby the need for therapy or prophylaxis in each disease could be questioned.

A further need for research on the homeopathic effect, the application within the various types of bovine mastitis and their self-healing ability is emphasised. These results showed that homeopathy might be an alternative possibility for treating bovine mastitis in organic and biodynamic agriculture. Attention should be paid to animal health and the individual conditions of the farm.

POSTER SESSION
OBSERVATION REPORT

Regeneration of honey bee colony with the warm process of swarming

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The vitality of the honey bee has decreased alarmingly for 20 years.

Nowadays, a professional beekeeper can't produce honey without artificial queen breeding, which are also often artificially fertilized. And he or she must also feed the colony with some sugar or some glucose.

In 1923 R. Steiner said that if the beekeeping developed artificial queen breeding, 80 years later, severe problems would appear. In the 1980s, (60 years after), the Varroa arrived in Europe and decimated thousands of hives, and in 2005 and 2008 the CCD (colony collapse disorder) removed also thousands of hives in USA and Europe.

Since then queen breeding became the only way to compensate for those important losses while the wild honeybee resists naturally.

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Artificial queen breeding and pathologies

The artificial swarming and queen breeding impede the warmth process, consequently favouring the development of diseases like the Nosema and the foulbrood. Also, these practices do not favour the total space of the nest, stopping the development of the varroa.

Swarming

Honey bee colonies reproduce by natural swarming. When the colony reaches two or three years old, it divides into two different organisms through a five-step process.

The first organism goes out of the hive with the old queen, the other one stays in the hive waiting for the birth of a new queen, which will be fertilized a few days later during a mating flight.

The five-step process is carried out by the warmth element, called swarming fever.

Colony A whose queen is two to three years old, extends its brood quickly in spring.

1) Expansion and dilation with the building of a queen cell and breeding of drones (male bees), then the increase of temperature before the first swarm B leaves the hive, just after the first queen cell is closed.

2) Chaos phase, when it goes out, the first swarm B scatters out of the hive with a loud humming. Then it settles on a branch before going into its new location. The temperature falls down, the swarm settles in a motionless cluster.

In hive A, the colony is orphaned for a week before the queen is born.

3) Individualization of both organisms with different smells. Colony B builds all its honey combs again with a new white wax.

The young queen is born in hive A, and it is then fertilized.

4) Regeneration of both organisms. 54 days after the laying of the first egg in the queen cell, all the bees of hive A's old queen are dead. Colony B changes its old queen in autumn or the next year.

5) Development of both organisms for two years. (Nowadays, almost every year the colony A totally disappears).

The study made by T. D. Seeley, of the Princeton University, on the wild colonies living in trees in the Arnot

forest, show the existence of a link between the use of the natural swarming process and the resistance of bee colonies to the varroa and to its impacts. This study reveals that the colonies reduces their size and swarm more often. For 30 years the bee colonies have stayed in this forest and they genetically adapted to resist the varroa.

Conclusion

Since 2005 the bee colonies I'm accompanying respectfully without queen breeding and artificial swarm and also without drug treatment, swarm much more often (one or two all the years) and produces also several swarms. These ones who stay in the swarming hive died and then, a new hive could be use.

The first swarm change often quickly the queen or the first year is the second, so it's a new colony which restarts.

This phenomenon is really an adaptation of colonies to the changes as T.D Seeley has observed the wild swarm in the trees.

In Natural beekeeping, the natural swarming process of the colonies who are respectfully bred seemed the most suitable solution, to allow for their survival.

Regrettably, it is not the choice of the professional beekeepers, even in organic beekeeping.

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BIODYNAMICS AND SOCIETY

KEYNOTE SPEECH

Participatory approaches in farmer-researcher collaboration

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In biodynamic agriculture many innovative measures are in use. They were partly developed in cooperation of farmers and researchers and there is still lying a great potential in that kind of on farm research.

Concerning animal husbandry, solutions for animal health, sustainable ruminant feeding, low stress slaughtering, young stock rearing, medicine use, natural breeding, keeping male animals, animal-human-relationship, barns for horned ruminants have to be found.

It makes sense to carry out research on-farm: to test, collect, evaluate and publish established or newly introduced methods the farmers have invented; so others will benefit from the pioneers' experiences. In many cases it is of advantage to test new measures, facilities, management tools or substances directly on farm; so we can see the results under practice conditions, which increase the external validity.

Nevertheless, there are also arguments against on-farm trials because conditions are more variable and often not as easy to control as under experimental conditions; statistical methods have to deal with the variable conditions, which often weaken the internal validity. Also farmers are often sceptic against research projects on their farms, because they can cause extra work or time consuming discussions, and some farmers think that researchers don't know much about practical farming.

The three of us, Mechthild as farmer, Anet and Silvia as researchers value the collaboration between re-

searchers and farmers and will present some examples of collaboration. Our common aim is to develop best animal husbandry conditions by observing their way of living and respecting their species-specific characteristics and their integrity.

Learning from farmer-to-farmer, assisted by researchers: Mechthild had started in 2006 to let the calves stay with their dairy mothers and additionally milked the mothers. In 2007 we visited her with a group of around 12 biodynamic farmers. Afterwards, most of them wanted to try out similar methods on their farms. We visited each farm with the whole group and watched the advantages and challenges of the respective method on each farm. Anet always wrote the minutes of those meetings. So, after 4 years we had gathered enough knowledge to write a practice leaflet which can be used by all farmers who want to apply dam rearing on their farm (Spengler Neff et al. 2015a). Other leaflets on keeping cows with horns, bull husbandry, calf rearing, kinship breeding and the value of horns for the cows were developed in a similar way together with farmers' groups (Spengler Neff et al., 20015b, 2016, 2017; Haugstätter et al., 21007). To be successful it is necessary that one person organizes the meetings and takes the minutes.

On-farm intervention studies as a combination of advisory work and research with one-to-one advice or advice within farmers' groups- facilitated by researchers (stable schools): "pro-Q" was a project to improve udder health and reduce the use of antibiotics (Ivemeyer et al., 2008). "Feed no food" was introduced to support farmers in reducing concentrate amounts in dairy cattle feeding (Ivemeyer et al., 2014; Leiber et al., 2017). The project "ANIPLAN" aimed at dairy cattle health improvements and minimizing medicine use by prevention considering farm-specific solutions and farmers' decisions (Ivemeyer et al., 2012). Common principles for active animal health and welfare

planning were developed within this project.

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OBSERVATION REPORT

Financial participation of the supply chain actors in organic plant breeding

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Plant breeding today is mainly done by multinationals and to a smaller extent by public research programmes, small companies and non-profit breeding associations. With the latest mergers in the global seed market, four companies are dominating more than 60% of the global seed and agrochemical market (Moldenhauer and Hirtz 2017). On the side of the small companies and non-profit breeding initiatives the trend is going in the other direction: almost all European countries have reduced their support and funding of organic breeding is becoming more and more problematic. Furthermore, in the Biomarket, most of the used varieties and seeds are derived from conventional breeding. So, the first requirement is full transparency of the origin of seeds and varieties across all stages of the value chain. The GZPK (Getreidezüchtung Peter Kunz) is working as a non-profit association for biodynamic plant breeding in Switzerland

and Germany. 10 FTE with a budget of 1 million/p.a. are organically breeding wheat (*Triticum aestivum* L.), spelt (*Triticum spelta* L.), durum wheat (*Triticum durum* Desf), triticale, emmer (*Triticum dicoccum* L.), peas (*Pisum sativum* L.), lupine (*Lupinus sp. pl.*), sunflowers (*Helianthus annuus* L.) and maize (*Zea mays* L.). 35 years of breeding work resulted in almost 20 varieties which are being marketed in Europe today (CH, D, F, CZ, IT, A, P), with a bio market share for Switzerland of 60 percent. Economic funding is one of the biggest challenges: only 15% of the budget are licensing fees and up to 80% are funds from foundations, contributions and private donations – money, which has to be raised annually. For the long production cycles of often 10 – 15 years, breeding needs both financial continuity and durability.

The activities of ecological breeding have benefitting impacts on three different aspects of our society: One is culture – seeds of cultivated plants are part of a common cultural property (biodiversity). Second

is real economy – as a market or trade commodity and third is the legal aspect – where a variety has its legal rights in form of protection.

Today in the traditional business model only farmers are paying the breeding services in the form of licence fees. But there are other users benefiting of plant breeding. How can all stakeholders along the supply chain be involved? The search for new viable concepts for financing a diverse, community-oriented plant breeding is linked to all stakeholders, beyond just government and market.

Involving processing companies in the breeding process is one option: GZPK is collaborating with a consortium of 11 oil processing companies in a sunflower project. Involving consumers with a crop plant per mille tax (CPPM) could be a very efficient and long-term financing solution. The CPPM is a kind of basic rate for long-term breeding of all cultivars, beyond commercial interest and success. According

to the Swiss Federal Council a continuous breeding programme of the 60 most important crops in Switzerland would cost approx. 20 million CHF per year. A CPPM of 0.1 percent (one per mille) of the market value of food plant products would result in a substantial subsidy for non-profit plant breeding of 30 million CHF per year.

Networking activities are key elements of future development for organic breeding: Ecological breeding needs a lobby! At national and international level, additional synergies and sources of financing can be opened up through communication efforts.

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SCIENTIFIC CONTRIBUTION

From the involvement of dissenting communities in a participative-action-research to uncovering responses to climatic and pathogenic threats specific to vines grown biodynamic

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Studies of biodynamic cultivation of vines have focused on economy and soil composition, on soil structure, soil biodiversity and microbiological activity, and on fertilizer effects. Studies of grape yield and quality, microbial communities in grapes and leaves, and wine biochemistry have also been reported. However, the results were not compared to conventional practice and have not resolved the controversy about the ‘anthroposophical paradigm’ at the heart of biodynamics practice. To date, the dissenting viticulture communities have not reached a collective plan to reduce the impact of viticulture practices on the environment and human health. We have tentatively addressed this problem holistically, bringing together the different stakeholders in a Participative-Action-Research. The workshops highlighted the dissensus among bio-

dynamic and conventional winegrowers, as well as among the non-government organizations, viticulture advisors, technicians, and research scientists. The dissensus stems from lack of distinct proof of the claims made, and from epistemic conflicts. Relying on a collective epistemology, the group arrived at the most sensitive and controversial issues. Co-designed questions were followed up by holistic comparison of conventional and biodynamic vineyard managements. We uncovered that the amplitude of plant responses to climatic threats was higher in biodynamic than conventional vines. The same stood true for seasonal trends and pathogens attacks. This was associated with higher expression of silencing and immunity genes, and higher anti-oxidative and anti-fungal secondary metabolite levels. This suggests that sustainability of biodynamic practices probably relies on fine molecular regulations. Such knowledge

may help Biodynamic viticulture development; but at first, it should contribute to resolving disagreements between stakeholders from dissenting viticulture and scientific communities, and help designing the awaited sustainable viticulture at large scale.

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OBSERVATION REPORT

Prév'mange – a pilot project for sustainable food systems in Prévèrenge, Switzerland

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This project started in 2016 and is on-going. It was initiated by REDD that works on sustainable food systems in Switzerland and abroad.

Sustainable food system projects are often initiated in cities. The idea here was to work in a larger village with a Municipality willing to improve the people's well-being and economy locally and globally through food. Associative economy wasn't initially at the base on the project but it turned out to be part of the actions that were chosen to lead the systems towards sustainability.

The actions that are being implemented are linked to education and human contact. Thus, the question is: can (hands-on) education and face-to-face meetings between producers and consumers lead to sustainable food systems locally and globally?

Prév'mange being a local field project more than a research project, our answer to this question will be based on local observations only.

The project started with an inventory of the actors located in Prévèrenge that participate in the food system. A small selection of actors was interviewed in order to better understand their activities and their

relation to other food system actors.

Based on the inventory and qualitative analysis, concrete actions are being implemented that could lead the local and global food systems towards more sustainability. Some actions are being evaluated by the participants and users with one-line surveys.

The inventory contains 33 actors. Three actors were chosen for interviews according to different criteria: the school with its educational garden, the school restaurant and the youth centre.

The analysis shows that school children and teenagers receive incomplete education about food systems. We supposed that adults also lack knowledge in this field and are disconnected from their food. Our hypothesis is that this lack of knowledge and connection leads to irresponsible food choices and unsustainable food systems.

Thus, several actions were designed to connect people to what they eat:

- A program of six visits of local food companies over a time period of one year (2017-2018). A biodynamic winegrower and winemaker, a fruit producer, the village bakery, the greenhouse of an organic vegetable producer, a village shop run by volunteers that sells local products only

and a vegetable producer that uses direct sales channels. A new program for 2018-2019 is being set-up.

- The development of teaching materials to encourage teachers to discuss food systems with their pupils. The idea is to link the classroom discussions with activities in the school garden and also with visits in local companies. This activity will start in April 2018.
- Changing the food choices available at the youth centre and organizing a prevention evening about food.
- The establishment of a community garden in the centre of the village.
- During two weeks, school children receive free apples for their break. Now the apples are local and organic.

The population of Prévelengues and the local actors are very enthusiastic about the project.

The local companies are interested in the visits. It gives them the opportunity to have a real discussion with their potential clients about their work and approach. This should have a positive impact on the number of clients, their loyalty and an increase in sales (not measured in the project).

An online survey has been filled out by the people that took part in the visits of the local companies. The results show the high satisfaction of the participants, a willingness to buy more local products and the desire to take part in more activities related to sustainable food systems.

These first results about the visits suggest that face to face discussions between producers and consumers are highly appreciated by both sides and lead to an increased willingness to buy local quality foods. This behavioral change can strengthen the local economy, reduce the impact on the environment and improve peoples' health.

SCIENTIFIC CONTRIBUTION

Synergies between solidarity economy practice and biodynamic farming enable new sustainable pathways in the food sector

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Organic farming and biodynamic agriculture are widely recognised as a promising way of greening unsustainable food systems. But they still fall short of their potential in terms of their shares in overall production. Combining organic farming, biodynamic agriculture, and the solidarity economy has come to be regarded as one possible strategy to foster the emergence of a new, sustainable development pathway in the food sector.

In this contribution – developed within the ongoing research project “The importance of the solidarity economy for the development of organic farming in Europe, past and present” – we discuss the development of solidarity economies in agriculture in selected European countries, with a special focus on

connections and interactions between the solidarity economy and biodynamic agriculture. The concept of solidarity economy is not novel; it evolved from 19th-century European social reformist cooperative movements. Accordingly, forms of solidarity in agriculture and in the food sector have long been practised; important examples include commons, cooperatives, share farming, and consumer–producer partnerships. The past two decades have seen a marked increase in new forms of solidarity economy in agriculture, often referred to as ‘community-supported agriculture’. Most of them include organic farming and/or biodynamic agriculture as an integral part of their principles and practice.

First findings from qualitative interviews and a website analysis in Switzerland, France, Germany, Austria, and Italy showed that biodynamic agriculture is overproportionately represented among solidarity economy initiatives, compared both to its general dis-

semination and to organic farming. In this contribution, we examine the reasons, by analysing ethical values shared by biodynamic agriculture and the solidarity economy, and by pointing out interfaces between the two, path dependencies, and potential for development. Historical interfaces between biodynamic agriculture and the solidarity economy can already be found in Rudolf Steiner's "Threefolding of the Social Organism", in which he postulated the advancement of cooperative forms of economy. Today, the idea and practice of communitarization of farms, land, and operating resources is another objective shared by biodynamic agriculture and the solidarity economy. The rationale behind it is that the fundamentals of agriculture and food, namely land and the means of production, should be used, managed, and protected democratically, as a responsibility of the whole of society. According to this view, farms and land should be removed from the flow of goods and inheritances and withdrawn from any form of speculation.

Endeavours to transfer property to a collectively administered trusteeship are often initiated or supported by actors from the biodynamic movement. Many of the biodynamic farmers we interviewed for our case studies are seeking to implement this model. Frequently, the communitarization of agricultural operations is achieved in cooperation with solidarity economy organizations who endorse some principles of biodynamic agriculture, such as Terre de Liens in France, Kulturlandgenossenschaft in Germany, or Stiftung Edith Maryon in Switzerland. These synergies between the solidarity economy and the biodynamic movement follow new patterns and hold potential

for making agriculture more sustainable, for example by creating new types of commons with collectively and democratically negotiated rights of use and responsibilities.

Methodologically, our contribution draws on 57 case studies in Switzerland, France, Germany, Austria, and Italy, for which we conducted structured interviews and focus groups. The findings were interpreted using a mixed-method approach that included quantitative and qualitative content analysis as well as direct cooperation with European partners through a transdisciplinary and transnational networking platform comprising 30 institutions.

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SCIENTIFIC CONTRIBUTION

Factors affecting farmers' decisions for the biodynamic farming method: the case of Slovenia

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Research question

Which are the factors affecting farmers' decisions for choosing the biodynamic farming method?

Research methods

Our research was constructed as a preparation of a Masters' degree thesis in an environmental sociology study program. Two research methods were used. Data about the characteristics of BD farms were collected using written questionnaire on a complete population of 28 BD farmers under Demeter control in Slovenia. Factors affecting decision making

process of farmers were identified during in-depth interviews with 9 BD farmers, which were chosen regarding the two indicators: type of production and duration of participating in BD farming (more or less than 10 years).

Results

In our research we included only certified BD farms under Demeter control, that means 28 farms with 236,36 hectares of arable land. One third of arable land are represented by meadows, which is a common characteristic of organic agriculture in Slovenia, mostly connected with geographic conditions and long history of extensive husbandry. What is special about biodynamic farming in Slovenia is that in BD also one third of arable land represents vineyards in comparison to organic farming where vineyards represent only 1,2 % of arable land. Unfortunately, land intended to grow grains, vegetables and fruit are weakly represented on biodynamic farms in Slovenia even though the demand is constantly growing.

Our qualitative research showed that there are many different factors affecting farmers' decision for BD farming. Firstly, care for personal health and natural environment, where growing food for market represents farmers responsibility also for the health of their consumers. Secondly, biodynamics became a belief and way of life, not only a farming method for the farmers. Third very important factor are meetings with other BD farmers and seeing how their farms are functioning in Slovenia and also abroad. Fourth and very common factor is collaboration with local biodynamic Associations, which represent important support system in a social and a counselling meaning and also a group involvement in the making of BD preparations. An active Demeter association of farmers, which provides information and advisory service formulated especially for BD farmers is very crucial. Significant, but less common factor for conversion to

BD farming is also anthroposophy, where Steiner's writing always connects agriculture with others parts of everyday life. All that BD farmers have in common is that BD presents them a challenge and impulse for further research and development.

Conclusion

Conversion into organic, and even more to the BD farming, is an important decision for a farmer, since the process takes several years and influences complete organization of the farm including changing the way of life and values of those who live and work on the farm. On the basis of the findings of foreign studies, we expected differences in hierarchy of factors among »older« and »newer« BD farmers, especially in the direction of bigger economic interests by the latest followers of the BD movement. But our research did not indicate any significant difference among the studied groups, which can possibly originate from value orientation of BD farming and that there are no additional state subsidies for BD farming.

Our empirical research showed that factors affecting farmers' decisions for BD agriculture are way more socially oriented than directly connected with agronomy and economics. It is essential to be aware, that farming is not just a topic of agronomy, but it is also a very important social phenomenon. It is urgent to use interdisciplinary approach with complementing agronomy and social sciences. That is the direction to better understanding of the decision-making processes for farmers, which is the basis for formulating a more effective (agricultural) politics and an actual active not only declarative step to develop more sustainable society.

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Farmers Learning Community “Con Respeto” based on Central-Eastern Spain (Albacete) building up healing impulses for mankind and Earth future

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Could the biodynamic approach to agriculture after nearly hundred years of development be still source of inspiration and will to build up social communities where learning to share both knowledge and resources are the central issues?

Going from a biodynamic preparations group work to a farmer learning community based on agri-cultural landscape activities, respect and cooperation.

Meetings to make preparations together started on spring 2011 at Las Encebras Farm (Pozocañada, Albacete) with periodical meetings every six months to share the making preparations together for group members: spring and autumn; so, dealing with biodynamic preparations work: elaboration, storage, application, supply for each member according to needs; was just beginning to binding together the members in a traditional way (Hurter et al., 2018). Later on the meetings moved from Central South-Eastern Spain farms (Albacete and Cuenca) to further away farms belonging to other group members: Valencia, Ciudad Real, Madrid, Murcia, Huelva, etc. That way the attendants could see on farm application of the biodynamic approach to particular conditions, crops, animals and view of the host farmer. Other workshops followed besides on plant goethean observation. A

couple of documents have been already translated into Spanish to share and discuss together. One in particular from Koepf (1993) is dealing with scientific results on the effect of biodynamic practices on soils, crops, animals and human beings very unknown in organic circles in Spain. Some on farm research observations have been carried out in cooperation with academic institutions. Furthermore, some innovative developments have been set up in particular farms, looking for practical improvements to apply into food production or processing: 1) a wine cellar with octagonal plant and no electricity to make special quality wine – Carrascosa de Haro Farm in Cuenca belonging to Parra Jimenez Family-. 2) Establishing a wet area within a pentagonal design surrounded by spirals of different trees and shrub species in order to improve air, warm and water circulation in a rather extreme continental climate landscape within Las Encebras Farm (Albacete) belonging to Alarcón Family. Members amounts nearly one hundred committed to attend every meeting plus invited observers depending on the place, coming from very different backgrounds: farmers, vegetable and fruit growers, researchers, artists, bankers, teachers, processors, dealers. They come for a true meeting of the others talents and needs source of true cooperation in the future. There is a very important representation in the group of the biggest Demeter farms in Spain as well as of dealers. Group's members have a long and very good connection with referent dealers in the Central European markets. Last but not least achievement of this community has been to hold last spring 2017 the first Fair and Conference on Biodynamic Agriculture in Spain with more than fifty stands and one thousand visitors in Albacete. Including talks on Waldorf education, complementary medicine, ethical banking, Anthroposophy, food quality, goethean science, etc.

Biodynamic agri-culture is a social and cooperative way of living involved in the building of healthy cul-

tural landscapes out of farm individualities designed and managed by the particular personality of the human community in charge of it. The work of Con Respeto learning community in Spain is growing and being known step by step. It is being able to empower Spanish biodynamic farmers as well as people with very different background that feel committed to this cooperative way of sharing knowledge and resources. It becomes that way a healthy and inspiring example

for others within the biodynamic movement as well as for the wider society in Spain and further away.

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POSTER SESSION
SCIENTIFIC CONTRIBUTION

The biodynamic productive structure in Italy: problems and perspectives

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Research question

The European strategy towards a circular economy intends to promote fully sustainable production systems characterized by reduced emissions and efficient use of low-waste resources. This model of production is considered at European level able to satisfy also market requirements, ensuring to companies adopting it a high level of competitiveness, full access to resources opportunities for economic growth, reducing market risks (price volatility), generating jobs, offering opportunities for integration and social cohesion. According to the European strategy production systems will have to meet the following requirements: to save energy, to reduce the risk of climate change, to conserve the biodiversity, to reduce the pollution of air, soil and water and to consume resources at lower rates than the Earth capacity to regenerate them. Biodynamic agriculture seems to be one of the agricultural production systems most able to meet all the requirements of the European strategy for the circular economy, placing itself as a reference also for other sectors of the economy, that want to adhere to the circular economy model. For this reason, it is necessary to analyse the characteristics of the biodynamic productive structures at national and

international level in order to evaluate the key factors in guaranteeing their environmental, technical and economic efficiency. In this aim this paper analyse the Italian case study to assess which factors are burdening the biodynamic growth at national level and which are enhancing its success, competitiveness and spread. The present study intends to analyse the characteristics of the biodynamic production systems, considering the whole production chain to assess whether biodynamic approach may be applied to other economic sectors.

Research Methods

The work was articulated in a literature review, in the company data collection of all the Italian certified Demeter companies, and in the creation of a dataset containing data on the company location on the GIS map, the SAT (Total Agricultural Area), the SAU (Agricultural Utilized Area), the production addresses expressed in OTE classes (Technical Economic Orientation) and the revenue. Statistical data analysis made it possible to identify consistency and relative regional differentiation, some productions of greater interest in the various territories and to quantify the level of differentiation of the sample. Starting from the micro data we analyse which factors are able to describe the differences among the sample. Then we select the key elements of the farming systems, such as the farm revenue, farm location, crop and activities differentiation and size and the organization of the supply chains comparing them with the other production systems. These key factors allow us to

describe the different feature of the biodynamic production systems along the country allowing to cluster the farms in different homogenous group. For each different group we submit a designed questionnaire to a sample of chain actors to identify the aspects of the biodynamic production systems, addressing weakness and strength of each different biodynamic group.

Results and conclusions

The results describe a highly differentiated sector able to maximize the multifunctional role of agriculture, which represents a niche reality able to act as a model for a wider spectrum of subjects and economic sectors. The paper also indicate which factors may burden the enlargement of the biodynamic at national level and address possible solutions.

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POSTER SESSION

OBSERVATION REPORT

How to Attract New Farmers to Biodynamics: Are Pictures of Nature's Unseen Forces an Answer?

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An issue of great concern in the United States is how to attract an aspiring farmer to biodynamic farming. Many conventional and organic agricultural choices are available: permaculture, the Korean method, bio-char, the GMO approach, hydroponics, aquaculture, of course biodynamics, and more.

Few Americans know what biodynamic agriculture is. After 80 years, the North American Biodynamic Association has only 1,200 members and just 1 of 42,360 acres is farmed biodynamically.

The challenge for any farmer is to maintain or improve the fertility of the soil and to grow high quality food. An abundance of research, farmers' observations, and consumer satisfaction shows that biodynamics does that and more.

When introduced to biodynamics, I wanted to know why it was so special. Two photos of soil profiles

provided the answer. The first photo was taken in a vineyard with poor clay loam, little root growth, and compaction. The soil was ripped deeply, seeded with pasture grass, and sprayed twice with the cow manure-based Preparation 500 (1 ¼ oz/acre). A year later, the soil profile showed 25 centimeters of darker topsoil with extensive feeder roots. Nature can take up to 4,000 years to accomplish this! All nine biodynamic preps use such a small amount of matter that their effectiveness is likely the consequence of unseen forces in nature.

Rudolf Steiner asked Ehrenfried Pfeiffer, a scientist, researcher, and farmer, to devise a way of showing these unseen life-force energies. He developed two processes: chromatogram and sensitive crystallization imaging. Some images require expertise to interpret, and even then the interpretation can be subjective. Others show unmistakable visual contrast such as Gerhard Schmidt's chromatograms of biodynamic and conventional milk and potatoes. The conventional

images look like black smut; the biodynamic ones are visually intricate and harmonious.

Sensitive crystallization pictures show a delicate branching pattern when life-force energies are strong. If the energies are weak, an aberrant pattern appears. In other research, strong life-force energies are also seen in a tiny microscope that shows the ferning pattern of a woman's dry saliva if she is fertile and ready to reproduce new life.

Cosmic influences are another unseen force that impacts plant growth and soil qualities. Research in this area includes compelling pictures of plants that demonstrate distinctive effects, such as stunted growth or perfect form.

Rudolf Steiner wrote, "Everything that the ego is able to unfold within itself is to become love." Dr. Emoto's water crystal pictures show how thoughts and feelings affect matter. "Love" and "Gratitude" written

on a piece of paper influence water as it freezes to produce an exquisite crystal, whereas the word "War" creates a distorted crystal.

Some can perceive unseen energies clairvoyantly without a picture. A friend and his seven-year-old daughter stood in line to check out at a high-end grocery store. She asked, "Dad, do you believe in auras?" He answered, "Well, yes I do." She replied, "You better put the food back then because it doesn't have any!" Most people have not yet developed the ability to view the unseen world in this way.

An Internet educational campaign that uses pictures and answers the question "Why choose biodynamic farming and produce?" could attract new farmers, more consumers, produce managers, and school and restaurant personnel. For the health of the earth and the potential benefit to all life, I believe it is my duty to help the world understand why biodynamics is so special.

POSTER SESSION
SCIENTIFIC CONTRIBUTION

Farming Collectives in South-West-Germany

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Research Question

The political and economic framework of agriculture nowadays seems to force farmers to optimize their businesses in a financial way alone. But as we see, this can lead to environment damage, termination of farms and stress for the few remaining farmers. Therefore, farming collectives (Ger.: Hofgemeinschaft) deal with these difficulties using a holistic approach. In this study a farming collective (FC) is defined as a farm, which is led by people who work together as equal partners. They live on one farm but are only partly related to each other. Their lifestyle focuses on sharing responsibilities, daily work routines and tasks of reproduction (household). Thus, they live a more traditional agriculture but without requiring their own children as the heirs to the farm. Since only a few articles about FCs could have been found, the aim of this study was to describe well-running FCs and to ask for their success factors. The research question

is therefore stated as "How are farming collectives structured and what makes them last?"

Research Methods

This qualitative research consists of two field studies with participant observation and guided interviews.

The farms have been found via internet and snowball-sampling. Thus, two farms have been visited for three days each. Both farms are located in South-West Germany (Baden-Württemberg). The first example is a Demeter-farm (Case 1) close to Lake Constance. There live five couples with their children and run a diversified 170 ha livestock-, crop- and manufacturing-farm.

The other example is a Demeter-farm (Case 2) close to Stuttgart. On that farm live two couples with their children and run a 70 ha diversified cattle-, crop and manufacturing-farm. Besides farming they include adolescents with a difficult social background in their daily work and run a cafeteria for tourists.

Through participating in the daily lives information on the structure and holistic characteristics of the FCs could be gathered. Furthermore, six guided interviews and one narrative interview were conducted. The interviewers information have been analysed using codes for finding typical structures (MAXQDA on Windows).

Results

In both cases we find diversified Demeter farms with defined responsibilities for each person. Although the tasks and their workload vary, everybody has the same right in decision making and gets the same salary. The FC acts as a solution to follow holistic ideals such as a diversified and sufficient farm or growing as/in a community. Asked for the main factor for FC to last, the farmers named social processes and discussion, but also defined responsibilities and a common vision for the farm. Conflicts for example can emerge from hierarchies or different individual capacities.

In contrasting the two cases it can also be shown that the two examples vary in many parameters. They differ in size, platforms for meetings, degree of shared daily routine and degree of shared responsibility. For example, in Case 1 the branches of the business are

strictly separated, whereas in Case 2 only the responsibilities are defined but all tasks are constantly talked through together.

Conclusion

The study illuminates a system of farms, that is not on the daily agenda of scientific research yet. Thus, it is an explorative study. By including only two farms this thesis needs to be seen as an introduction into a new field of future research pointing out two examples which made collective farming working. The study illustrates an opportunity to follow biodynamic ideals in the framework of a price orientated market. It also names success factors as seen by farmers with a long experience on well-running farms. The results shall be noticed by both, (farming) communities and future researchers.

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RESEARCH METHODS AND BIODYNAMICS

KEYNOTE SPEECH

Multi-actor and transdisciplinary research for a new agriculture based on living processes

Chable Véronique

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Between a “living soil” and “food for life” there are micro-organisms, plants and animals, which contribute to a food chain where all components work in synergy to provide a sustainable food system. Uniformity currently dominates at every level in modern society and has thus reached the entirety of the food production process, disrupting the intimate link between agriculture and the living processes. Seeds play a key role in these systems. The seed sector however, thanks to modern genetic knowledge, has privileged stable and uniform varieties, to fulfil the requirements of the industrial agri-food system.

In the late 1990s, the European Organic regulation introduced the obligation for organic producers to use organic seeds. Today, even though the seeds used in organic agriculture derive almost entirely from organic production, very few of the varieties used have been selected for organic farming. In the mid 2000’s, a European joint venture between farmers’ networks and researchers was launched, setting up an innovative multi-actor and transdisciplinary research model. The goal was to promote diversity, from the soil to the plate, exploiting diversified plant populations (Chable and Serpolay, 2016). What better way to produce organically than using organic adapted seeds: living seeds for a living soil!

Both the intuitions of the organic movement’s pioneers and the most recent scientific developments have emphasized the key-role of soil life and its diversity for healthy plant growth. Among these ecological processes, the symbiotic interactions between plant and microorganisms are becoming increasingly recognised as pivotal for plants’ fitness (i.e. survival and

reproduction) and agro-ecosystems’ performance (Vandenkoornhuysse, 2015). Cultivated biodiversity has been reduced by intensification, causing a loss of biodiversity in the soil food-web (Duhamel and Vandenkoornhuysse, 2013). From a biodynamic point of view, seed is even considered as the male pole that fecundates the Earth, representing the female pole. For this reason, the origin of the seed and organic practices should be regarded as the corner stones, upon which build authentic and efficient organic food systems.

An essential goal for organic research is to promote and to re-introduce diversity in the food chain by means of deploying diverse plant populations. Plant populations have the ability to better exploit diverse environments, consisting of soils and climates on one side; local farming and cultural practices on the other. Experiences with farmers and their networks in Europe and other continents have shown that it is possible to successfully implement *on-farm* plant breeding and seed production (Chable et al, 2014). Participatory and multi-actor research offers a powerful tool to connect these *on-farm* based activities with each other and increase their impact, particularly in the organic sector. However, this newly generated transdisciplinary knowledge also benefits society as a whole (Ortolani et al, 2017).

The revival of crop diversity has been achieved through a number of steps: (1) exploration of the remaining landraces still used in farms and stored in gene banks since the 1980s (more than one million accessions have been stored in European gene banks); (2) proposition of new plant breeding strategies to generate new landraces, adapting it to the target environments and the different agricultural practices for high quality food production; (3) establishment of Community

Seed Banks to collectively manage seed production and exchanges, and, through this, the renaissance of peasant seed systems; (4) promotion of diversified food value-chains within local markets to foster a new food culture, helping citizens to reconnect with nature through healthy nutrition for themselves and for the planet.

Multi-actor and transdisciplinary research for organic agricultures introduces a paradigmatic shift, which invites researchers and all actors aspiring to a new organic world to anchor their activities in a set of values exclusively founded on the “living” and on “diversity”, rather than on market laws and the consequent materialist and reductionist vision of natural processes.

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KEYNOTE SPEECH

Systems Comparative Research Methods and Results in Biodynamic Agriculture

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Question

Do Biodynamic Preparations and Cosmic Rhythms have significant effects on agricultural yields and produce quality and how to find reliable research methods to test them? Examples: Pioneer Philosopher-Scientists Eratosthenes of Cyrene and Hipparchus of Nicaea. Corroborability, Testability, and Logical Probability in Natural Sciences. Repeated observations and Statistically Designed Trials. Short review of comparative general agricultural and biodynamic systems trial results: IBdF, FiBI, Wye College, WSU, ABD and UFFS.

Methods

Comparative Systems (BD, Organic, Conventional & Control) Medium-Term Field Trial with Wheat, Potato

and Allelopathic Green Manure Rotations – Wye College, 1993–2000. Spring wheat (*T. aestivum*, var. Canon) and potatoes (*S. tuberosum*, vars. Cara and Pentland Crown) in rotation with rye (*Secale cereale*) plus vetch (*Vicia sativa*) mix simulated an organic farming system. Field trials were supplemented by laboratory and glasshouse experiments. Crop yield and health, nutritional and keeping qualities of produce as well as soil nitrogen content levels were the parameters evaluated. The experimental design was based on randomized complete block blind experiments, with secret codes for both compost, soil and spray treatments: A=control, A+= chemical fertilizer and foliar spray, B&C=blind BD & Organic, using 60 T ha⁻¹ of standardized compost treated with preparation sets and sprays blind-labelled B&C. Double-blind re-coding of samples was used before quality assessments of both wheat and potatoes. Successive cropping seasons (1993–95) in the same plots, were used to check for cumulative effects, with crops cultivated in spring/summer of 1993–95 and rotation with rye/

vetch mixture for green manure and weed control (1994). The biomass was left as mulch in B&C plots and removed from the control plots.

Results

Contrasts of interest have shown statistically significant differences, as follows: Wheat – the Agrochemical system produced higher grain yields than the average of the Organic & BD systems (A+ vs B* or C*), while the latter also significantly increased yields in relation to the Control (A vs B* or C*). The Agrochemical system resulted in lower quality than all others in terms of Thousand Grain Weight (TGW; $p\{A+ \text{ vs } A, B, C\} < 0.001$) and baking properties (HFN* - Hagberg Falling Number). The BD treatment showed optimal HFN (249.83; $p\{A, A+, B \text{ vs } C\} = 0.003$) with a lower phosphorus** content than the Organic (the highest in P), while other element levels like Ca, K, Na, NO₃ and Ash did not vary significantly in the grain. Potatoes – While the treatment systems produced significantly different mean fresh yields*, dry weight yields did not differ between the systems A+ vs B&C and A+ had the lowest dry matter content ($p\{A+ \text{ vs } A, B, C\} = 0.001$). The BD system had a significantly higher tuber conservation after a 6 month storage period (less browning) compared to the others ($p\{A+, A, B \text{ vs } C\} = 0.036^*$). The Organic system produced a higher amount of "chats"* (tubers < 40mm) than the BD. There were overall differences between treatment systems* and varieties***. The Agrochemical system resulted in much higher soil NO₃ levels through and after the cropping season for both wheat and potato plots, which did not reflect in proportionally higher yields and is undesirable for soil water quality.

Conclusions

Significant quality differences between Bio-dynamic and Organic treatments indicate plant metabolic allelopathic regulation by the BD preparations, showing the way to detect these subtle effects. Much higher soil nitrate levels in the positive control "A+" plots did not increase proportionally the yields, but significantly correlate to lower quality in both wheat and potatoes. Results show the possibility to improve crop yield and quality of produce, through simple and environmentally adequate techniques, directly available to farmers. Research methods are a form of dialogue with natural phenomena.

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OBSERVATION REPORT

The gap between scientific relevance and scientific acceptance

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Research question

What experiences are there where results of research beyond the boundaries of materialism are included in the scientific discourse without losing their specific

value?

Abstract

In "The Science of Knowing" (GA2) Rudolf Steiner challenges us to choose a method for research that fits to the subject. For the research into vitality specific methods are developed like crystallisation, chroma's,

etc. These methods require personal training in order to learn to feel and read the images. This makes it difficult to talk about it in general. Attempts to present the results in quantitative terms may yield successful correlations but lose the qualitative image descriptions.

Some researchers apply their intuitively found values when advising on agriculture and nutrition, without worrying about their scientific communicability. Others design their research in such a way that this com-

municability is a very important element.

The view that finding applications for research results is more fruitful than trying to be successful in the scientific discourse can be supplemented by the need to include the person who applies the results in the process where the results were obtained.

Research method(s)

Interviews with researchers about their intentions and experiences.

SCIENTIFIC CONTRIBUTION

Sustainable Yogic Agriculture and Reflections on its Relation to Biodynamic Agriculture

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Indian agriculture is presently undergoing a process towards regeneration in light of the shortcomings of industrial agricultural practices implemented during the Green Revolution. Biodynamic agriculture is making inroads in the country but there are also ancient and new Indian agricultural practices that are being rediscovered and implemented at the present time. One of these practices receiving high profile attention and increasing popularity is 'Yogic Kheti' or 'Sustainable Yogic Agriculture' (SYA) which was launched by the Brahma Kumari Rural Wing (2009). The Brahma Kumaris World Spiritual University is a spiritual movement led by women established in 1937 headquartered in Mount Abu, India and has currently over 9000 centres in 135 countries. How does the current practice and research of SYA overlap with the aims of agroecology and biodynamic agriculture? Brahma Kumari worldview states that all human beings are pure souls inhabiting a physical body. It is believed that the soul consciousness, having traits of purity, bliss and love, are considered as one's true nature instead of body consciousness, the latter having resulted in the present afflictions worldwide. The Brahma Kumari teachings share some tenets with anthroposophy and originated within the same time

period. Both movements were birthed from a spiritual impulse which subsequently branched out to focus on practical initiatives for the betterment of humanity worldwide including education, agriculture and medicine. In addition to teaching its unique way of Raja Yoga meditation, the Brahma Kumari movement is presently making direct impact (Ramsay, 2012) in the agricultural sphere with 'Yogic Kheti' or 'Sustainable Yogic Agriculture' (SYA) which was launched in 2008. SYA farming is built on the foundation of organic farming principles and thus prohibits all chemical fertilisers and pesticides, but also puts a strong focus on meditation and positive intent by the farmer to create a healthy farming system and community (Ramsay, 2012). The methodology of this paper is to provide a review of the existing published literature and research that has been carried out regarding this philosophy and method of SYA farming practices in India (Ramsay, 2012). The research results will be analysed in light of worldwide research published about the effects of positive human intent on crop growth (Ducharme, 2007; Roney-Dougal & Solfvin, 2003; Radin, 2000). Furthermore, an overview is presented from farm case studies and interviews carried out in India from field work conducted with the Brahma Kumari Rural Wing in November 2017. SYA is premised on the philosophy that 'as the food so the mind and as the mind so the body' drawing another parallel with biodynamics. However, rather than using specific preparations the core component of SYA is to

first train farmers in the practice of Raja Yoga meditation emphasising 'inner' change as a precondition for 'outer' change on the farm itself and society at large. It is estimated that there are between 1000-2000 farms in India using SYA methods. Interest and uptake of SYA is growing across India via state-wide and national campaigns that are supported by the government. Research carried out by Indian agricultural universities in recent years indicate many positive benefits of SYA in terms of community wellbeing and crop quality compared to conventional and standard organic practices (Ramsay, 2012). The results of the interview and case studies will be analysed together

with the data gathered from a two-day meeting with Indian biodynamic farmers hosted by SARG India during the same time frame. A brief overview will be presented on how the worldview of anthroposophy relates to and is differentiated from the Brahma Kumari worldview to establish a framework for possible future collaboration. The similarities and differences between biodynamic agriculture and SYA will be discussed with the consideration whether or how these two farming systems could be practiced in synergy in the context of Indian agriculture but also worldwide.

SCIENTIFIC CONTRIBUTION

Exploring the Cultural Landscape of Biodynamic Research

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It has been proposed that "there is a need for rethinking the approaches, processes, and institutional structures of agricultural research, because of the range and scale of consequences that agricultural research is expected to address today" (Alroe and Kristensen, 2002). Does this proposal apply in the context of biodynamic research? – or research into biodynamics? If it does, can Alroe and Kristensen's proposals for a research framework contribute to a rethinking of approaches to biodynamic research? This paper focuses on the first of the three elements of research named above – i.e. the approaches to research. It engages with a critical consideration of

Alroe and Kristensen's publication and brings to this consideration an evaluation of Steiner's lectures on Human and Cosmic Thought. This paper, and the framework discussed, aim to address the distinction between natural and human science which still dominates scientific discourse today, but which becomes problematic in the context of research in the context – or 'landscape' – of biodynamics.

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SCIENTIFIC CONTRIBUTION

Visual Gestalt evaluation of biocrystallization images: ranking wheat samples from different production systems

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Research question

Biocrystallization images are obtained in the course of evaporation of the water from organic extracts like food in presence of copper chloride. The structures of

the crystalline structures are known to reflect food quality, such as degree of decomposition. Experiments have been conducted by a group of 8 research scientists from 5 institutions. In the present study, the main focus was on improving the visual evaluation by being aware of the kind of consciousness of the researcher during his analysis of the crystal images.

As a first step a standardized and scientifically applicable method was developed in order to characterize the gestalt of the crystal images at a higher-level of observation. The gestalt of images is related to plant-physiological processes. In compliance with the scientific ISO-norms 11035 and 8587, a group of experts can work out evaluation domains based on criteria. Our group worked out and tested the evaluation domains "aging process" and "maturation". The test results showed a ranking of the encoded images with statistical significance for both evaluation domains. These results indicated that the visual evaluation of encoded images can be learnt and taught.

In the perceptual science, two arts of visual evaluation were differentiated: a) an "analytical evaluation" that mainly focused on the parts of the image, and b) a "qualitative evaluation" that takes in consideration information from the whole image. The working hypothesis of the present project was that the evaluation reliability is improved if the "analytical evaluation" is completed by a "qualitative evaluation" based on an empathic observation of the images.

Research method

Crystal images of wheat from the so-called DOK long-term experiment (FIBL, Switzerland) were investigated. A panel of 8 evaluators was trained in the visual assessment of biocrystallization images and asked to rank the visual Gestalt decomposition level of encoded images of wheat extracts from biodynamic, bioorganic organic, conventional (included mineral fertilizer combined with manure) and only mineral fertilization production systems aged for

the same amount of time. Each of the panel members simultaneously received 14 encoded evaluation sets in random order collected from the four different production systems at one of five aging times. The panel was asked to rank the biocrystallization images according to the specified criteria of decomposition.

Results

In the evaluation with only "analytical criteria", images of samples from the two organic or the two conventional production systems could be distinguished with high agreement according to their Gestalt decomposition level with fewer signs of decomposition in the images of organic samples. The rank order between the two organic systems vs. the two conventional systems was significant.

In the evaluation with "qualitative criteria" (based on an empathic observation of the images), images of samples from all four production systems could be distinguished with high agreement according to their Gestalt decomposition level with fewer signs of decomposition in the images in the rank order: biodynamic < bioorganic organic < conventional < mineral. The rank order between the four systems was significant.

Conclusion

These first results verified the working hypothesis that the evaluation reliability is improved if the "analytical evaluation" is completed by a "qualitative evaluation" based on an empathic observation of the images.

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Eurythmic treatment of apples for quality modification

Grundmann Eckart

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Preface

One of the objectives of the work at Institute ArteNova is to make eurythmic treatments applicable in organic agriculture. Given that the appropriate gestures can be found eurythmy could be a tool to improve both process and food quality. By learning the basics of eurythmy and integrating it in their work farmers can also find a new relation to the beings they are working with, e.g. plants, animals, or landscapes. In previous projects we could find a significant effect of eurythmic treatments on the taste of garden cress. So, we aim to confirm these results with other agricultural products.

What is eurythmy?

Eurythmy is a moving art given by Rudolf Steiner in 1913 which transforms non-visible life and soul forces to visible human movements. For every letter of the alphabet (representing a sound) he gave a specific gesture which is also a specification of a quality of life, e.g. concentrating forces in the gesture B or a flowing process in the L. Eurythmy is traditionally done as a performing art on stage, as therapeutic eurythmy, or as social eurythmy in groups. At Institute ArteNova we formed a new approach by using eurythmy to treat plants and substances to modify their quality.

Research question

A biodynamic apple farmer asked Tanja Baumgartner, an eurythmist practicing at the Institute ArteNova, to work on the quality of apples with eurythmy gestures. He wanted to get apples of the variety Ariwa more sweet and crunchy. In the second year we added the variety Rajka. Our main objective was to find out if it's possible to create an appropriate sequence of eurythmic gestures for a predetermined purpose.

Research methods

In cooperation with the farmer T. Baumgartner created one sequence of eurythmic gestures for improving sweetness and one for the crunchiness. Additionally, she made a sequence which was combining sweet-

ness and crunchiness. They were applied seven times from the flowering in April to the harvest in September. Each treatment took 10 minutes per tree. The eurythmic gestures were made with the arms in front of the apple trees. The trees (variety Ariwa) were chosen by the farmer. The apples have been harvested by the farmer under standardized conditions (size, color, number). In the pre-project the apples were tested at FiBL for sugar content and steadiness of the fruit pulp. In the second year the apples of Ariwa and Rajka were treated with only one sequence for an integrated improvement and degustated by 80 people in a sensory laboratory with a rating in a scale from 0 to 100.

Results

In the pre-project the apples which were treated for more sweetness showed a significant higher value of sugar content (15.6 degree Brix) than the combined treatment (13.9 degrees Brix, $p=0.01$) and the control (14.2 degree Brix, $p=0.02$). All eurythmically treated apples had by trend a higher steadiness of the fruit pulp (8.51 kg/m²) than the untreated control (8.13 kg/m², $p=0.057$).

In the sensory test in the second year the treated apples of Ariwa have been rated by trend sweeter than the untreated. But in the variety Rajka the untreated apples were slightly sweeter than the treated. The total judgement of the quality was highly significant higher at the eurythmically treated apples in both varieties (Rajka: 69.6 vs. 66.8 points, $p=0.006$; Ariwa: 81.0 vs. 76.0 points, $p<0.000$) The apples of Rajka were significantly more crunchy than the untreated (55.4 vs. 52.0 points, $p=0.019$). In the parameters amount of taste and freshness the treated apples showed significant higher values than the untreated.

Conclusion

The project showed the following facts about eurythmic treatments:

- 1.) It is possible to find appropriate eurythmic gestures for a predetermined purpose. It requires an intensive examination of the involved processes by the euryth-

mist to find the proper gestures.

2.) People can taste the differences of such a delicate modification in the surrounding of the plants.

The question if the effect comes from the movement or eventually from the mind of the dancer cannot be answered by the used experimental design. It is the experience of the eurythmist that her living forces connect to the forces of the trees by doing eurythmy and effect a reaction.

In summary the quality of agricultural products can be principally modified by eurythmic treatments. The

actual situation including the variety, the treating person, or the conditions on the farm has to be regarded. So the concrete results of eurythmic treatments can vary subject to these factors.

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SCIENTIFIC CONTRIBUTION

Screening of analytical methods for eurythmically treated water

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Preface

In several previous experiments we showed the effect of eurythmic treatments on water with the *Hiscia* cress test. Different eurythmic gestures and durations of treatment lead to various effects on cress seedlings irrigated with the treated water. In terms of understanding the eurythmic treatments we were looking for analytical methods which can test the effects on water directly.

What is eurythmy?

Eurythmy is a moving art given by Rudolf Steiner in 1913 which transforms non-visible life and soul forces to visible human movements. For every letter of the alphabet (representing a sound) he gave a specific gesture which is also a specification of a quality of life, e.g. concentrating forces in the gesture B or a flowing process in the L. Eurythmy is traditionally done as a performing art on stage, as therapeutic eurythmy, or as social eurythmy in groups. At Institute ArteNova we formed a new approach by using eurythmy to treat plants and substances to improve their quality.

Research question

Which analytic methods show differences in eurythmically treated water samples? Do they give indications for a qualitative characterization of the used

eurythmic gestures?

Research methods

The eurythmist Tanja Baumgartner treated spring water in four replications over one year with the gestures for B, L, S, K, and W plus a non-eurythmic just moderately moved variety and an untreated control. The treatments were carried out for 15 minutes per letter and day over seven days. The gestures are done mainly with the arms in front of and around the water samples in a distance of ca. 50 cm. The water samples were delivered to external institutes for the following tests (having regard to the four levels of the human being):

1.) physical: UV-spectroscopy, fluorescence spectroscopy

1.) physical and 2.) life forces: rising pictures and biocrystallisation, drop picture method

2.) life forces: cress test, algae test

3.) soul and 4.) spiritual forces: constitutional analysis, research on formative forces

The water samples were blinded regularly. Except two institutes used non-blinded samples according to their methods (sections 3 and 4). The institutes worked autonomously using their regularly applied observation and statistical methods. The following methods didn't work with statistical data but with descriptions

of observations: rising pictures and biocrystallisation, drop picture method, constitutional analysis, and research on formative forces. The results of the tests were assessed separately and in comparison.

Results

Eight of the nine analytical methods showed differences between the water samples. In the UV-spectroscopy, fluorescence spectroscopy, and the cress test significant differences between the eurythmic treatments could be found. In the algae test some of the varieties were consistent over the four replications and others were not. In the drop picture method no differences could be found.

In the rising pictures and biocrystallisation W, B and "non-eurythmic movement" were clearly characterized and allocated to the quality "wide" and S and K were allocated to the quality "tight". The constitutional analysis and the research on formative forces described groups of samples with specific qualities. In a number of tests and parameters the results could be ordered in a ranking between low and high values or extreme qualities. The test methods allowed a

grouping of the results in two groups with related (similar) validations. The control variant (not moved) got no specific assignment.

Conclusion

Eurythmic treatments influence water quality which can be found with different analytical methods in different fields. The comparison of the tests shows similar qualities of the eurythmic gestures. In further projects the test method can be chosen regarding the specific objective of the experiment.

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SCIENTIFIC CONTRIBUTION

INBIODYN: Integrated, bio-organic and biodynamic viticulture. A comparative study over a 10-year-period

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Demand and production of organic and biodynamic crops have been growing exponentially in the last decades around the world. The organically managed viticultural surface in Europe increased substantially from 43.000 ha in 1998 to 230.000 ha in 2011, corresponding to around 5.3 % of all vineyards within Europe. Some of the most prestigious domains have converted to organic or biodynamic viticulture, respectively. However, little research has been conducted on the impact of these management systems on vine growth, yield and product quality.

In 2006 a viticultural field trial (INBIODYN) comparing integrated, organic and biodynamic viticulture was established at Geisenheim University in Germany. Yield, pruning weight and sugar content of the must

differed significantly between treatments over a 7-year-period (2006-2012). The integrated treatment showed significantly higher pruning weight, yield and significantly lower sugar content of the must compared to the organic and the biodynamic treatment. Reasons for the changes in growth, generative performance and must quality will be discussed.

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OBSERVATION REPORT

Thoughts from collating biodynamic research ... and possible development

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Research question

Can one find an ideal form for biodynamic research and development?

Research method(s)

The essential method is common to the first stages of all academic research, that is collection and collation of previous research results and literature. Considera has managed to gather a significant body of work based on the results of using the preparations, whilst attempts to do the same for timed plantings and pepping have not been successful.

ResultsThe data in Considera's collection varies in academic robustness and in supplying essential context. This raises many questions about method including reflection on the suggestions that Dr Steiner offered

for those at the Koberwitz course concerning the agricultural circle and Dornach. In the expectation of biodynamics fulfilling its potential, of biodynamic agriculture as a successful and mature discipline, a simple and general (but unsurprising) form for research has emerged which reflects the Philosophy of Freedom and other basic anthroposophical works. An example of this becoming practical is offered.

Conclusion

A form for BDR&D (biodynamic research and development) is offered. Looking for patterns in existing research has stimulated discussion and considerations for future practice.

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www.considera.org/reslit.php and www.considera.org/phpBB3/viewforum.php?f=17

SCIENTIFIC CONTRIBUTION

Experiences with new and alternative research methods at Hiscia Research Institute

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Background

In biodynamic agriculture, specific procedures and preparations are being used with the aim of increasing soil fertility, plant health and hence food quality. Also for the production of remedies as used in anthroposophic medicine various, specific pharmaceutical procedures are applied in order to modify and to enhance remedy efficacy. All these procedures and

preparations are based on the anthroposophic view of man and nature, and are sometimes controversially discussed regarding their specificity, efficacy and mode of action.

Research questions

Can the effects of anthroposophic pharmaceutical processes be scientifically investigated and which methods might be suitable for such kinds of investigations?

Research methods

At Hiscia Research Institute, different pharmaceutical processes, like a specific blending process for winter and summer mistletoe extracts on a high-speed rotating disk, as well as homeopathic potentization have been investigated using laboratory plant bioassays (*Lepidium sativum*, *Triticum aestivum*, *Kalanchoe daigremontiana*, *Sinapis alba*, *Lemna gibba*, *Pisum sativum*), microbial bioassays (using yeasts), different cell lines as well as picture forming methods. In all investigations it was necessary to specifically adjust the design of the experiments to each research question, i.e. to decide about the most appropriate controls and to be aware of possible factors that may influence the outcome of the experiments. In order

to avoid false-positive results, it was helpful to include Systematic-Negative-Control-Experiments in the experimental design, since they show the natural variability occurring in a bioassay.

Results

Using the whole plant bioassays, we observed that anthroposophically processed mistletoe extracts induced a stronger protection effect against colchicine induced tumors or UV damage compared to unprocessed mistletoe extracts, whereas in single cell based bioassays no differences were observed. Also for potentized preparations, whole plant growth models proved to be more useful compared to cell based assays. With picture forming methods mistletoe extracts from different host trees could be differentiated and characterized.

Conclusions

Compared to simple single cell based assays, complex systems and outcome measures proved to be more useful to identify and characterize the effects of anthroposophic pharmaceutical processes. We presume that this is due to the specific mode of action, which we hypothesize to be of regulative nature.

SCIENTIFIC CONTRIBUTION

Participative development of a guideline for scientific documentation of casestudies in biodynamic agriculture as part of a research framework

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Developmental needs in research methodology for biodynamic (bd) agriculture

Until now several effects of bd measures were shown as statistically significant in scientific research. Effects were found in different areas / parameters. Effects are partly compensatory or even contradictory. In many cases we are not able to predict in which parameters which effect will occur. In many studies there were no effects of bd measures found (several of these not being published). Specific recommendations for practioneers are scarcely possible at current

state of knowledge.

I hypothesize that „agricultural individualities“ (in the sense of Rudolf Steiner) may react differently or contradictively on the same measurement

This would explain why in randomized trials the standard deviation often is very high and why results often are not statistically significant.

And we are lacking criteria to decide, whether different farms are matchable / similar enough to be included in a randomized trial.

Solutions from complementary / anthroposophical medicine

Complementary medicine faces very similar problems, when investigating into effectiveness of remedies. It developed two solutions, interesting for bd research:

a) Standards have been developed for scientific report on case studies, case series and non-randomized cohort studies. These together representing about 60% of total evidence in medicine. Additionally, case series and non-randomized cohort studies.

b) Very specific tests have been developed in order to clear out which people may be included in randomized studies; the tests show whether a patient belongs to a very narrow subgroup of a certain disease.

Case studies in research for bd agriculture

In agricultural research case studies are hardly developed and acknowledged methodologically.

When transferring these solutions from medicine to agriculture some specialities and differences have to be considered; e.g. the double role of the farmer as framer of the agricultural individuality and at the meantime as observer / therapist.

A Proposal of standards for scientific documentation of case studies in bd agriculture will be presented; and a proposal how to develop scales / indices to evaluate the comparability of farms will be presented.

Research Framework

Taking into account the above challenges and solutions regarding research for bd agriculture a research framework will be proposed showing interrelations of different steps and methods of research for bd agriculture and how these may lead to better knowledge and more relevance for practical bd agriculture: alteration of experience/phenomenology and conceptbuilding; conceptbuilding as part of the conscious scientific process; casestudies to compile the influencing / effectual factors; development of scales/indices to facilitate comparability of farms; case series and cohort studies; randomized studies; develop deep understanding of concepts brought by anthroposophic spiritual science; fundamental research in biology; integration of "mental/psychic observations following the method of natural science" (Rudolf Steiner, subtitle to philosophy of freedom); cooperation of practioneers and researchers;...

Participatory Development

Proposals of standards for scientific case studies, of scales/indices for facilitating comparability of farms and of research framework, should be discussed and further developed in a participative process of many researchers and practioneers.

OBSERVATION REPORT

How could agroecology research and biodynamic agriculture benefit from collaborating on intuitive farming explorations?

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To date, modern scientific research to support farmer decision-making has typically taken a cognitive (logical, rational) approach, focused on producing explicit (external, tangible, codified) knowledge. This has yielded formal tools, built around information communication technology, that aim to model agroecosystems, decision theory and support practical management decision-making. However, while such

tools are highly useful, new research is showing that farmers do not adopt them as expected. Farmers with more productive, efficient and healthy farming systems prefer to rely more on other, tacit (internal, intangible) ways of knowing than are generally recognised or spoken about. In this research, farmers in Germany, Austria, the Netherlands, UK and New Zealand identified intuition as the main faculty they use to inform, accelerate and customize most of their decisions, with significant qualitative and quantitative benefits (Kieft, 2015; Paxton, 2017; Nuthall, 2018).

Additionally, many of the farmers surveyed claimed

that their success stemmed from intuitive communication or 'meditative listening' with organisms on their farm or the whole farm, to obtain more detailed information for their practical decisions. The farmers also believed that everyone can develop such abilities, and that internal observation processes are crucial for their development.

The concept of human communication with other-than-human forms of nature beyond classical modes is not new. Anthropological research has revealed that it is embedded in the worldview of many indigenous cultures worldwide. There is also much scientific evidence to support this notion, with quantum physics offering potential explanations for the underlying mechanism(s) (Erickson, 2016).

Rudolf Steiner, the founder of biodynamic agriculture, described intuition as a form of higher knowledge, and a necessary faculty in accessing information about other beings (Steiner, 1967). While biodynamic certification for farms currently only regulates physical practices, Steiner's teachings encourage farmers to develop their self-observation abilities, attune to other-than-human farm elements in a Goethean manner, and incorporate the information gained in their practical decisions. Academic data is not easily available on the extent to which biodynamic farmers use these practices; however, that there is a systematic approach available to farmers means that biodynamic agriculture is the only form of modern, Western alternative agriculture that proactively recognizes and encourages intuitive farming.

There is much that agroecology can learn from the biodynamic perspective of improving the health and resilience of the 'whole farm organism'. There may be even greater value in collaborative, transdisciplinary explorations between agroecology researchers and biodynamic practitioners into supporting farmers in leveraging their latent resource of intuition to do so. Researchers are beginning to acknowledge the importance of farmers developing their intuition but

focusing on the biodynamic approach to developing and applying intuition could be the kind of radical impulse from which agroecological research could benefit even more.

In turn, the biodynamic community could benefit from scientific findings that recognise the value of these and other biodynamic practices. This might help change how conventional farmers and mainstream researchers perceive biodynamic agriculture and help spread the awareness and practice of biodynamics. It may also encourage biodynamic farmers to deepen their intuitive abilities and more consciously use them in practical decision-making.

The current rate of progress of mainstream agricultural improvement will likely not be sufficient to meet the United Nations sustainability and food security goals of the next few decades. This alliance may help reinvigorate agricultural research towards more efficient, customised and coherent practices and, ultimately, resilient farming systems.

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A Call for the Biodynamic Movement to Come Out about Spiritual, Non-Material Farming Philosophy and Practice

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Arguably the most underplayed characteristic that Biodynamic farming can offer the rest of the sustainable farming community is its philosophy, science and practice in and of the non-material world. For organic and agroecological farming already meet multiple sustainability goals (Altieri, 1995), yet they continue to share with industrial agriculture their scientific basis in the visible material dimension. However, throughout the majority world of less-industrialised countries (and in industrialised countries pre-1600s), a different paradigm exists that recognises the invisible, subtle energies and forces and, importantly, the crucial need to interact with them as part of our land-based activities. This paper argues that it may be time for the Biodynamic Movement to 'come out' more strongly with its non-material dimension, for the following reasons: 1) Whether through meditation or plant medicines, young people are wanting to

learn more about this; 2) Anecdotal evidence from farm advisors report an approximately 30% increase in farm performance through such practices (de Souza, 2006); 3) It would add credibility to the call for cognitive justice for indigenous farming cultures and practices that are currently being eroded; 4) if sustainable agriculture claims to be holistic then it cannot ignore the wave-based nature of reality; and 5) the rise of applied quantum science may provide us with philosophies, concepts and terms that enable us to discuss and explore this nonmaterial dimension more easily. The paper concludes with an outline of research recommendations to take this forward.

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Why Biodynamics? Research, Observations, and Inspiring Stories. An Unwritten Book that Addresses Issues of Concern in Biodynamic Farming

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In the United States there is an issue in both biodynamic food and farming that needs to be addressed. Few consumers or farmers are aware of the qualitative differences of food grown biodynamically or the consistent soil improvements the method typically engenders. Of all the organic farms in the U.S. only 1 out of 50 is biodynamic.

How does the general public learn about these qualitative differences? In the U.S. few books document biodynamic research: Herbert Koepf's *Biodynamic*

Research and Adalbert Count Keyserlingk's Developing Biodynamic Agriculture, and Maria Thun's Work on the Land and the Constellations. The North American Biodynamic website also has the results of research. It takes considerable effort for the general public or a busy farmer to look deeply into biodynamics by the above means. In addition, documentation of research can be quite dense for someone who is isn't already keenly interested in the subject.

Why Biodynamics? Research, Observations, and Inspiring Stories intends to bridge this gap with a 125-150 page book of diverse compilations of research,

observations, and stories of farmers and gardeners. The enticing, draw-you-in, format, similar to Maria Thun's, *Gardening for Life*, will present information in a simple, clear manner which answers for both the consumer and farmer, "Why Biodynamics?" "What is so special about biodynamic food and farming?" Each subject will be brought to life with pictures, illustrations, charts and graphs which have only the most essential, visually appealing information. The tightly written text will weave fascinating facts and information of an educational and instructional nature throughout.

The book will include a basic understanding of the biodynamic practices and the threefold task of biodynamics of worldwide significance which Rudolf Steiner outlined in the agricultural lectures: To Spiritualize the sciences, Sanctify the earth, and Help counteract the worldwide danger threatening man's nutrition.

The U.S. co-director of Demeter, Jim Fulmer, strongly agreed that there is a definite need for such a book. He often finds himself in a position to educate farmers on the basics of biodynamics many of whom know little about biodynamics or anthroposophy. He cautioned that the format and content would have to "capture the imagination of even the strongest critic."

Examples of the content are: Alex Podolinsky's soil profiles of pasture after 3 months without rain; Sherry Wildfeuer's trigon experiment in Dornach; Walter Goldstein's chicken preference test; Henning's comparison of liming to Pfeiffer's Field Spray; Colum Riley finding DDT in compost from San Francisco city waste even though it's been banned for manufacture in the United States since 1972. Material outside of biodynamic circles will also be included, such as Dr. Emoto's water crystal work which demonstrates the power of the spoken and written word to transform matter.

Further research in biodynamics will always be needed as we all evolve, grow, and deepen our understanding of the living earth and cosmos. We will continually face new challenges in agriculture, such as radiation, chem-trail, and pesticide pollution, the impact of GMO activities, the myth of a "Stable State" of weather, availability of water, and in-puts, and the continuing degradation of soils and food.

There is a need to cooperate and collaborate in the emerging global environment where multiple perspectives are needed to ensure a sustainable, enlightened future. And most importantly, the outstanding research results need to be made available to farmers and the general public in succinct forms which are clear, simple and easy to understand.

POSTER SESSION
SCIENTIFIC CONTRIBUTION

Systematic review of biodynamic agriculture

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Since 1970 numerous research projects have been conducted to assess the efficacy of biodynamic agriculture. Regularly, literature reviews have evaluated their overall results. The review of Turinek et al. (2009, p.146) concluded: "Nevertheless, as explored in this review, a fair share of the available peer-reviewed research results of controlled field experiments as well as case studies show effects of BD preparations on yield, soil quality and biodiversity. Moreover, BD preparations express a positive environmental impact in terms of energy use and efficiency." How-

ever, Chalker-Scott (2013, p.817) came to opposite conclusions: „To date, there are no clear, consistent, or conclusive effects of biodynamic preparations on organically managed systems. [...] Given the thinness of the scientific literature and the lack of clear data supporting the efficacy of biodynamic preparations, biodynamic agriculture is not measurably distinct from organic agriculture and should not be recommended as a science-based practice at this time." These different conclusions can be partly explained by the disparity of the references. Indeed, only nine references are common in Turinek et al. (2009) and Chalker-Scott (2013).

This comparison shows the necessity of a systematic review that evaluates all conducted research projects on the basis of a transparent methodology.

This work has recently been initiated at the University of Kassel. We intend to identify, select, categorize and evaluate all research projects about biodynamic agriculture since 1970. This review will be conducted according to the standards developed for systematic reviews. Depending on the available results, a meta-analysis might be conducted as well.

The first results of this systematic review will be presented.

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