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2nd International Conference on Biodynamic Research

Growing beyond resilience

August 30th to September 2nd 2021 / Dornach, Switzerland (online)

Conference Contributions

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Growing beyond resilience

Opening up Biodynamic Research

Contributions to the
2nd International Conference on Biodynamic Research

August 30th to September 2nd 2021 / Dornach, Switzerland

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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.

From 30th August until 2nd September 2021 the 2nd International Conference on Biodynamic Research (BDRC21) took place. Altogether ten partners have met to organise a varied, broad program for the conference. More than 60 contributions from more than 15 countries are shaping the program.
The event took place digitally to include people from all over the world, fitting the various time zones across the globe.
At the conference the conversation on the theme "Growing beyond Resilience" is encouraged. Here, academic, participative, and practice-led research from farming work and the food system are brought together.
We invite people to discuss critical questions on resilience: what concepts are there at present? How are they being lived out? Are they fostering or hindering further development? What forces are needed to move beyond present conditions?

This booklet contains the abstracts of the papers, posters and workshops presented at the conference. Some of them are more scientific research oriented, while others are more observational papers. 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 program committee, the organization 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, August 2021

Lin Bautze, Christopher Brock, Jonathan Code, Petra Derkzen, Jürgen Fritz, André Hach, Jasmin Peschke, Neil Ravenscroft, Regina Sharmila Dass, Anet Spengler-Neff, Richard Swann, Saskia von Diest, Verena Wahl, Johannes Wirz, Julia Wright, Jean-Michel Florin

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Parallel Sessions:

Viticulture

Effects of biodynamic management of vineyard soils in Burgundy on aggregate stability and visual evaluation of soil structure.

***Dr. Jürgen Fritz*[1]**, *Finja Lauer[1,2], Anette Wilkening[1,2], Pierre Masson[3] , Stephan Peth[2]*

[1]Organic farming and Cropping, University of Kassel, Nordbahnhofstr. 1a, 37213 Witzenhausen, Germany, j.fritz@uni-kassel.de

[2] Section of Soil Science, University of Kassel

[3]BioDynamie Services, Les Crêts ,71250 Chateau, France

An on-vineyard approach was used to investigate the effects of biodynamic preparations horn manure and horn silica (BD) on soil structure in five vineyards on different bedrocks that had been under organic management for different time periods (Fritz et al. 2021). The underlying hypothesis was that the effects of biodynamic preparation increase aggregate stability and improves soil structure assessed by visual evaluation (VESS). The aggregate stability during wet sieving was not changed with biodynamic preparations (BD+) compared to without (BD-). An improvement in soil structure based on VESS with BD+ compared to BD- was not significant for macropores/biopores; drop test topsoil and subsoil colour. In contrast, significant changes were observed in the drop test subsoil ($p = 0.009$), topsoil colour ($p < 0.001$), root penetration ($p = 0.017$), structure surface (stable aggregates and little encrustation, $p = 0.006$), structure topsoil ($p = 0.030$), structure subsoil ($p < 0.001$) and colour change from topsoil to subsoil was in a deeper soil layer ($p = 0.049$). Based on previously reported results showing that significant changes in the microbial activity of BD+ compared with BD- of same soil samples were found, it was thought possible that the differences in the activity of the microbial community in the soils was the cause of the structural differences the soil with BD+ compared to BD-. It was recommended that further investigations it should be examined whether the joint occurrence of altered microbial activity and soil structure improvement in VESS of BD+ compared to BD- can be observed at other sites.

References

Fritz J., Lauer F., Wilkening A., Masson P., Peth S. (2021): Aggregate stability and visual evaluation of soil structure in biodynamic cultivation of Burgundy vineyard soils. Biological Agriculture & Horticulture (submitted).

Keywords

Aggregate stability; horn manure, horn silica; VESS; viticulture.

Ringversuch 2020 - Crop management with potentised preparations in viticulture

B.Sc. Michel Nehren[1], *Benjamin Epler[1]*

[1]Agroto GmbH Contact number: (+49) 0160 5968231, m.nehren@gmx.de

Research question

The research project is centred around the application of potentialized biodynamic preparations in viticulture. Main goal was to determine whether or not potentialized preparations would show equivalent effects on the morphological structure of grapevines, as the common application of the biodynamical preparations does, during one growing season. Adding to that, we tried to reduce the use of copper, by linking application times and techniques to specific physiological stages of the vine.

Research method

Eight different wineries and one university (listed below), in seven different viticultural regions of Europe took part in this project. All project partners selected the vineyard site on which this experiment takes place by themselves. To keep track of all applications, the growth stadium on the vines, plant health and additional factors like the weather we scheduled once a week by phone calls. During the season of 2020 there were two timeframes in which we physically collected data on site. The first one was an assessment of the vegetative growth, where we assest length of main shoots, amount of watershoots and we counted the leaves on both. Also we took a picture of the order of leaves along the shoot. Later we used the collected data to calculate the length of internodes. The second assessment focused on generative growth. We documented the amount of clusters per vine and shoot, the amount of berries per cluster, the weight of clusters and berries and the cluster compactness. Through calculation we estimated the potential yield. To get an idea of the quality of the grapes we send samples to France, where Madame Chapelle performed copper chloride crystalization with grape juice samples.

Results

For most of the indicated parameters there was no difference shown between common biodynamical treatment, using potentialized preparations and the application of potentialized preparations linked to specific physiological stages. The only factors that showed major differences were cluster compactness and the copper chloride crystallizations. Through the application of potentialized preparations linked to the physiology we found a higher percentage of loose clusters. The chrystallization pictures indicated a better inclusion of terroir, more balance in flavours and in general a better ripeness of the grapes when treated with potentialized preparations.

Conclusions

So far our study has shown, that applications of potentialized biodynamic preparations have an equivalent effect on plant growth in viticulture.

Keywords

Potentialized preparations, plant health, terroir

Culture and Integrity

The Agricultural Course as a Milestone in Fertilization

M.Sc. Rayan Scariot Vargas[1], *PhD Andréa Cristina Dorr[2], Jéssica Righi de Oliveira[1], PhD Fernando Silveira Franco[4]*

[1]Federal University of Santa Maria, Post Graduation Program of Rural Extension, e-mail: rayan_scariot@hotmail.com

[2]Adjunct Professor at the Department of Agricultural Education and Rural Extension at the Center for Rural Sciences and Permanent Professor at the Postgraduate Program in Rural Extension at the Federal University of Santa Maria-RS. e-mail: andreadoerr@yahoo.com.br

[4]M Associate Professor at UFSCAR, Campus Sorocaba. ember of the board of the Brazilian Association of Agricultural Bodinamics and the Brazilian Association of Agroecology.- e-mail: fernando.agrofloresta@gmail.com

With the advent of modern agriculture, organic inputs were replaced by inputs from the chemical industry, permanently changing the landscape and the way in which human beings relate to nature. During the second half of the 19th century and the beginning of the 20th century, the chemical industry had a great technological rise, partly subsidized by interests of the war industry that reflected the desire for territorial expansion and nationalism that the great economic powers at the time. The present work seeks to understand how Biodynamic agriculture engendered in 1924 is characterized as a break from the synthetic fertilization paradigm and its historical weight for the way human beings fertilize the soil. In this way, the present article has an explanatory character, as it pursues to understand the historical significance of Biodynamic agriculture in its conjuncture. Thus, with a bibliographic search developed based on material already prepared, consisting mainly of books and scientific articles. (GIL, 2008, p. 44). We understand that, although biodynamic agriculture was consolidated in 1924, it was structured around a rescue of the holistic view of life already contemplated by other ancient cultures. According to Jovchelevich (2012, p. 292), Biodynamic agriculture values this knowledge and expands it, incorporating the other rhythms of the moon and the movement of the planets related to agricultural activities in general. Therefore, for Steiner, the development of a landscape that is harmonious with nature, once established, will guarantee a permanent fertility of the soil, plants and the human being itself. Surprisingly contrary to this force of rationalization of biological processes initiated more forcefully by Justus Von Liebig and later materialized in the Haber-Bosch process of synthesizing ammonia, Biodynamic agriculture, with its landmark in the Koberwitz convection in 1924, represented a milestone for humanity as a resistance to the dissociation of human beings with nature when striving for living processes, in an effort, always continuous, to cultivate food and products respecting the idiosyncrasy of plants and the rhythms of nature. The agricultural course was a new impetus to combat the current thinking of the time that masked cosmic processes with dead science.

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Keywords

Biodynamics; synthetic fertilization; Koberwitz

Biodynamic farming: an exception to the whitewashing of indigenous agriculture?

Dr. Julia Wright[1]

[1]Coventry University, Centre for Agroecology, Water and Resilience, j.wright@coventry.ac.uk

Biodynamic farming, along with organic farming, permaculture, agroecology, regenerative agriculture and more, are all modernist approaches to food production that arose over the last century as rational alternatives to industrial farming. Whilst the latter is typically characterised by a

reductionist focus on maximising yields and profits through technologies aimed at suppressing and controlling nature, those modernist, western, alternative farming approaches deliberately strive to take a systems view of farming, optimising a more considered range of outputs through a collaborative relationship with nature (Ponisio & Erlich, 2016).

In doing so, almost all alternative agricultural approaches claim to draw from, or be based on, indigenous knowledge and farming systems from Southern countries, and to combine these knowledges with scientific advances (see for example Altieri & Toledo, 2011).

It is this claim that has led to a recent critique by a consortium of sixteen indigenous leaders and organisations which states that regenerative agriculture and permaculture offer only narrow solutions to the climate crisis. Called "Whitewashed Hope" (2020), the critique encourages these western farming movements to go deeper than simply taking indigenous practices out of context, but rather to encompass the worldviews they represent and in doing so to enable the cultural and relational changes needed for humanity's collective healing.

The critique identifies six key areas of divergence between modernist western and indigenous worldviews around: dualism versus monism, dead matter versus the consciousness of all life, the notion of good and bad versus a relational striving for balance, the limitations of modernist languages, the need to consider the historical relationship of people to land, and the interconnectedness of human-Earth healing cycles.

This paper takes a critical analysis perspective to evaluate the argument made by this critique against the worldview of the biodynamic farming approach. Drawing from Steiner's agricultural lectures as well as other materials (Steiner, 1993), it posits that, to some degree, biodynamic agriculture stems from a worldview that is relatively more similar to those of indigenous cultures. The paper goes on to attempt to qualitatively identify the extent of this similarity and concludes with a discussion around the application of the term 'indigenous' in

relation to modernist western farming regions.

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Keywords

Indigenous, worldviews, biodynamic, whitewashing

Opportunistic agroecological adaptation by farm women under semi-arid conditions of Rajasthan, India

Dr. Dheeraj Singh[1]

[1]Central Arid zone research institute, Krishi Vigyan Kendra, dheerajthakurala@yahoo.com

Climatic vulnerability and exposure to multiple stressors have compelled small-holder farmers world over to develop location specific knowledge and adaptation strategies to sustain their livelihoods in risk-prone ecosystems.

Under these conditions Madhu Devi a local female farmer of Pali district utilized agroecological knowledge to convert stress into opportunity with autonomous adaptation. The major stress in this area are high temperature, hot and dry winds, low and delayed monsoon, high salinity in ground water, erratic rainfall and early recession of rains. The farmer is having her land at scattered sites in Hemawas dam which is used to store runoff water in catchment area of around 260 hectares of land. The farmer very effectively utilizes the conserved soil moisture in Hemawas dam catchments area for crop diversification under varying moisture regimes. The stress of climate variability and salinity in varying landscape traditionally used for cultivation of wheat, barley, chickpea and mustard with low yield, has now been substituted with muskmelon as opportunistic adaptation (Wang et al., 2008). The terminal heat and aberration of temperature during February-March negatively impact yield of winter season crops.

This variability is now adapted with introduction of muskmelon a fruit vegetable relished for its taste and sweetness. This is a three months short duration cash crop, cultivated with very minimum external inputs and moderate farmers' vulnerability (Jackson et al., 2004). In the land, freed from water, she grows muskmelon in the conserved moisture during last week of February. Sowing is done by simply ploughing the land to open up the soil in the open spaces using local seeds specially treated with luke warm water and kept in moist jute bags overnight for easy germination. This adaptation is continued when there is very minimal competition with other agricultural enterprises and related. The farmer plank the field when the seeds germinate and attain 2-3 weeks age to trap the moisture and level

the field (Patil et al., 2014). This also controls the insects attacking the crop by burying the eggs deep and sealing the soil. The seeds germinate and utilize the runoff organic matter and conserved moisture for luxurious growth and high yield. Easy market through organized muskmelon's contractors at field itself makes this adaptation further robust for the farmers' livelihoods.

This location specific agroecological adaptation further empowers other rural women, who are landless and relatively more marginalized. They are the main actors in the entire operations of the muskmelon's cultivation where either they contribute as family labour or as daily paid laborer earning cash from land owners. This adaptation provides an insight for the formal science about how formal and informal knowledge can be hybridized to co-produce more robust adaptation to convert stressors into opportunity.

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Keywords

Semi-arid climate, conserved moisture, agroecological knowledge, opportunistic autonomous adaptation, muskmelon

Response to biodynamic management in Burgundian vineyard soils on functional microbial diversity

Dr. Jürgen Fritz[1], *Ramia Jannoura[2], Finja Lauer[1,2], Jona Schenk[1,2], Pierre Masson[3], Rainer Georg Joergensen[2],*

[1] Organic farming and Cropping, University of Kassel, Nordbahnhofstr. 1a, 37213 Witzenhausen, Germany, j.fritz@uni-kassel.de

[2] Soil Biology and Plant Nutrition, University of Kassel, Witzenhausen, Germany

[3]BioDynamie Services, Les Crêts ,71250 Chateau, France

An on-vineyard approach was used to investigate the effects of biodynamic (BD) preparations on soil microbial biomass and microbial functional diversity in five vineyards on calcareous bedrocks under organic management (Fritz et al. 2020). The vineyards formed two groups according to soil type; Cambic Leptosols (A1, A2, and B) and Calcaric Leptosols (C1, C2) as well as two groups according to duration of BD application; 16 years (A1 and A2) and 1–3 years (B, C1, andC2). The two Calcaric Leptosols contained on average 65% more microbial biomass C, 110% more microbial biomass N, 70% more ergosterol and exhibited a 45% higher basal respiration rate than the three Cambic Leptosols. The vineyards had, on average, 11% lower MB-C:N ratios in the treatments with the BD addition (BD+) than in those without (BD). Most substrates induced the highest respiratory responses at vineyards A1 and A2 and the lowest at vineyard C2. Averaging the 17 substrates of the multi-substrate-induced respiration (MSIR) approach, the mean respiratory response was approximately 20% lower in the BD+ treatment at vineyard A1 in comparison with the BD- treatment, but 33% higher at vineyard C2. The differences between the BD treatments in the induced respiration rate for individual substrates were significant for 12 substrates at vineyard A1 and for 5 substrates at vineyard C2. The lower the respiratory response, the higher the anabolic demand for a specific MSIR substrate, indicating C limitation of the soil microbial community. The current results suggested that BD preparations have balancing contrary effects on the microbial functional diversity under different soil conditions and that these effects may increase with the number of years of application. More vineyards should be analysed to differentiate between the effects of soil type and duration of BD application.

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Reference: Fritz J., Jannoura R., Lauer F., Schenk J., Masson P., Joergensen R. G. (2020): Functional microbial diversity responses to biodynamic management in Burgundy on vineyard soils. Biological Agriculture & Horticulture, 36(3), 172-186, DOI: 10.1080/01448765.2020.1762739.

Keywords

Microbial biomass; ergosterol; multi substrate induced respiration; limestone; viticulture; horn manure

Investigations of vineyard soils in France with and without the application of biodynamic spray preparations

***Dr. sc. agr. Heberto Antonio Rodas Gaitán*[1], *Jürgen Fritz*[1]**

[1]University of Kassel, Organic Farming and Cropping Systems, Witzenhausen, Germany, heberto.rodas@yahoo.com

The research project aims to study the effect of biodynamic preparations horn manure and horn silica (BP) on physical, biological soil properties, as well as visual assessment from 18 vineyards located in Bourgogne, Baux de Provence, and Avignon, France.
To understand possible transformation processes, soil sampling will take place every six months during three years. All vineyards are organically managed, but considering two plots for treatment with BD (BD+) and without BP as a control (BD-). Six replicates were collected (0-10 cm) in each plot through the slope. Soil samples were sieved (<2 mm) and stored at 4°C prior to analysis. For the first soil sampling (Autumn 2020) following laboratory analyses were considered: General soil analyses: Dry mass, pH, carbonate, total C and N, soil organic carbon. Soil biology: Basal respiration, microbial biomass C and N, ergosterol, multi substrate-induced respiration. Soil physics: Water holding capacity, aggregate stability as mean weight diameter (MWD), bulk density, contact angle, texture, water-retention process.

Preliminary results of four vineyards were already obtained (48 samples): During the air-drying process soil samples began with a similar water content (22-26%). After eight days (until a constant weight was reached) the moisture averages were higher in treatments without BP. The water was probably retained in the fine pores, making it less available to the plants ($pF^{>}5$).

In such sense, the experimental results could mean that the availability of water was increased by the BD application. Aggregate stability results were not statistically different between BP- (4.51 MWD) and BP+ (4.54 MWD), but between different locations. pH had significantly higher values in BP+ (7.85) compared to BP- (7.69) and increased significantly along the slope (7.56 and 7.99 in the bottom and top position, respectively). Contact angles (CA) were significantly lower in treatments with BD+ (105.4°) in contrast to BD- (108.7°). BD affected positively CA (lowest values), turning the soil more hydrophilic. CA significative difference was found between the bottom (111°) and top position (101°) of the slope. Basal respiration was significantly higher in BD- (14.9 µg g–1 soil d–1), in comparison with BD+ (13.6 µg g–1 soil d–1).
Lower microbial basal respiration rates may indicate higher carbon storage in soils. BP application showed a positive effect on some physical soil properties, which need to be studied over different seasons and linked to microbial activity.

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management. European Journal of Soil Science, 56(2), 239-251.

Keywords

Biodynamic agriculture; viticulture; microbial activity; contact angle; aggregate stability

Animal Welfare

Selection concept based on Vitality and Resilience for extensive organic Beekeeping of the Dark Bee Colonies

***Dr. Ariane Maeschli*[1], *Dr. Salvador Garibay*[2]**

[1]*Research Institute of Organic Agriculture FiBL, Departement of Livestock Sciences, ariane.maeschli@fibl.org*

[2]*Research Institute of Organic Agriculture FiBL Department of International Cooperation Ackerstrasse 113 5070 Frick Switzerland salvador.garibay@fibl.org*

According to breeders in Switzerland, dark bees can only be successfully conserved today if the beekeeper observes the characteristics of pure breeding and buys the queens from recognized breeders. However, this leads to a narrow genetic breeding selection, which can also cause some one-sidedness, such as the loss of vitality.

In this project we developed a selection concept for bee-related, extensive organic beekeeping based on vitality traits to get a locally adapted and healthy dark bee. We would be interested to know if an adapted selection concept for extensive organic beekeeping management meets or contradicts standard breeding criteria and whether main criteria can be observed during the year that can help the beekeeper make an assessment.

In 2018, three apiaries were located at 3 locations at different altitudes (400-1000-1500m above sea level) around Lake Lucerne. Each apiary was of 12 bee colonies per location and kept for 4 years. The bees were kept according the biodynamic guidelines, which includes the building of natural honeycomb and reproduction based on the swarming process. Just short to the swarming, the mother colony was divided in three sub-colonies. All sub-colonies were maintained at the same apiary. This with the aim that young queens resulted mated with the populations of drones from the apiary as much as possible. However, wild crosses with other drones, depending the altitude might be possible.

An extensive data collection was carried out four times a year, which included, depending on season, the following standard selection criteria: natural colonies losses, bee health, bee colony size, varroa infestation, aggressiveness, calmness, cleaning behavior, weight of the hive. Additionally, locally adapted criteria as vitality (building activity, brood nest quality, behavior, swarming) and resilience (adaptation to environment, feed storage in brood chamber) were included. The sub-colonies for continuing breeding were selected in spring 2020 and 2021, based only on survival characteristics as health, vitality and resilience.

At this time point it seems that progenies of more aggressive colonies show better vitality and resilience. Further interesting observations: small hives may have some advantage to spend wintertime, may to less food consummation. In summer some colonies stop the brood at poor feeding condition, as it is known of african bees. Large differences were also found in the amount of storage of nectar and pollen. As expected, it was not possible to keep a purebred dark bee, but more coloured bees were observed in the hives. It remains unclear whether crossbreeding has a positive or negative impact on resiliance and vitality.

According to the results obtained, we would be interested to know whether a selection concept according to vitality and resilience would positively influence the health of dark bee colonies and whether it would be possible to define clear characteristics of a hive in order to define a resilient, locally adapted bee during the bee year.

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Keywords

Dark bee, extensive beekeeping, vitality, resilience, breeding

Agronomic performances of organic rocket cultivation in greenhouse: a comparison among intensive (Business as Usual), biodynamic and agroecological systems of production

Dr. Fabio Tittarelli[1], *Baiano S.[2], Trotta S.[1], Bilotto M.[2], Ciaccia C.[1], Testani E.[1], Morra L.[2]*

[1]CREA- Agricoltura e Ambiente - via della Navicella 2, 00184 Rome, Italy, fabio.tittarelli@crea.gov.it

[2]CREA - Cerealicoltura e Colture Industriali - Laboratorio di Caserta –Via Torrino, 2, 81100 Caserta

Organic greenhouse production can be very intensive (Voogt et al., 2011) and is object of

strong debate among actors within the same country and among different countries in the framework of the European Union (Blom, 2011). After almost a decade of discussions, the recently published Regulation on organic production Reg (EU) 2018/848 has introduced, for the first time, new rules regarding organic production in protected conditions.

"Organic and biodynamic vegetable production in low-energy GREENhouses – sustainable, RESILIENT and innovative food production systems", is the multidisciplinary project which has been funded in the framework of CORE Organic Co-fund (Tittarelli et al., 2020).

In the Italian experimental site, three main production systems were compared to a Control not fertilized (CNT: i) Business as Usual (BAU), an intensive organic system of production based on the use of organic fertilisers and pesticides allowed by organic regulation (according to the input-substitution approach) and on the regular use of soil solarization to control weeds and to protect crops from soil-borne pathogens; ii) Byodinamic (Biodyn), a system of production based on the biodynamic method, with the introduction in the crop rotation of mixed green manure species during summer, the use of biodynamic compost and biodynamic preparations (500 and 501); iii) Agroecological (Agroecol), an organic system of production based on the introduction in the crop rotation of green manure species during summer, the use of biowaste compost and of pesticides allowed by organic regulation, when needed.
Compared systems were assessed according to a multidisciplinary approach taking into account commercial yields, nutrients availability, potential risk of nitrate leaching, weed diversity, soil arthropods, nematodes and microbial biodiversity, and soil suppressiveness.

In this paper, we focus our attention on the agronomic performances of the biennial cultivation of rocket (Eruca sativa Mill) in compared systems. Yields of rocket in compared systems did not differ from the CNT in the 2018-2019 cycle; they ranged from 23.6 Mg ha-1 in Biodyn to 29.1 in CNT. In the 2020-2021 cycle, yields generally lowered and the compared systems did not differ again from the CNT. However, yields decreased 14.1 Mg ha-1 in CNT, 6.9 in Biodyn, 6.2 in Agroec, 7.3 in BAU. Due to soil solarization, the potential risk of nitrate leaching was by far higher for BAU than for Biodynamic and Agroecological method.

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Keywords

System comparison, nutrient availability, agroecology, input substitution

PREPARATIONS

Assessment of 501 influences on vegetative growth and berry metabolism of the grapevine variety Verdicchio

***Dr. Mario Malagoli*[1],** *Masato Giulio[1], Zago Adriano[2]*

[1]Department of Agronomy Animal Foods Natural resources and Environment University of Padova - Viale dell'Università, 16, 35020 - Legnaro PD – Italy. Contact: mario.malagoli@unipd.it

[2]Mastrilli Consulting, Via Imprunetana per Pozzolatico, 113, 50023 Impruneta, Italy, adriano@mastrilliconsulting.com

The application of biodynamic preparations in the vineyards has raised scientific interest in the last years. The preparations are claimed to stimulate soil nutrient cycle, photosynthesis in plants and optimal evolution of compost, enhancing both soil and crop quality (Reeve et al., 2005). In particular, preparation 501 is believed to act on the aerial part of plants stimulating their ability to catch light and to adjust a series of internal mechanisms, including the defence against pathogens, the response to biotic stress, the vegetative growth and the maturation of the fruits (Brock et al., 2019)
Positive effects on soil characteristics, plant growth, yield and biodiversity were evidenced in vineyards cultivated with biodynamic system (Döring et al., 2019). Picone et al. (2016) found changes in grape berry metabolome, likely related to physiological response of the plants treated with preparations. The application of 501 was noticed to positively affect the quality of grapes and wines (Fritz et al., 2017).

The present study aimed at investigating the effects of 501 on the grapevine variety *Verdicchio*.
The research was set in two vineyards in Marche region (Italy), with the application of four 501-treatments during the grapevine growing season: from pre-flowering until near the maturation. During this period of time a series of morphological observations (shoot length, number of leaves, number of clusters) and analytical measurements (foliar pigments content; soluble solids, acidity and poliphenols in berry juice, thickness of berry skin) were performed in plants exposed and not exposed (control) to 501. This to assess and better understand any possible influence of the 501 applications. Particularly, grapevine plants of *Verdicchio* cultivar were selected in two vineyards, one with grafted plants and the other with un-grafted plants.

Overall the results revealed significant responses of the plant to the 501 treatment. The content of chlorophylls increased by 13% in the 501-treated leaves and the carotenoids accumulated 22% more than in control leaves. The concentration of soluble solids in mature berries resulted significantly higher (+7%) in grape exposed to 501 than in control, concurrently with the weight of the berry skins. No variations were detected in the polyphenol content of the berries.

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Keywords

501, grapevine, growth, berry composition

Casting light on the reason by which manure is stuffed into horns in Biodynamic Agriculture preparation 500: the keratin catabolism evidence

Dr. Michele Lorenzetti[1], *Andrea Squartini[2]*

[1]Ass Culturale Professione Biodinamica, miklorenzetti@libero.it

[2]University of Padova, mail: squart@unipd.it

Research question

The main practice in Biodynamic agriculture is the use of a preparation (Horn manure) obtained by the underground overwinter maturation of cow manure stuffed into cow horns. Such protocol has always been the object of skepticism by supporters of strictly conventional agriculture due to its apparently ungrounded basis and seemingly casual rationale. The question was whether there would be any biochemical meaning in having chosen horns as incubator shells for manure.

Research method(s)

Using a DNA sequencing-based taxonomical analysis and rescuing buried horns at different time intervals we followed the successional composition of bacteria and fungi throughout the process, from initial cow manure, throughout a series of intermediate stages, up to the mature Preparation 500.

Results

Marked shifts in the microbial community were seen involving a general decrease from a Firmicutes-dominated material to a product transiently enriched in Proteobacteria and later in Actinobacteria, mostly within the Nocardioidaceae family. But the most striking finding was that the dominant fungus in the initial manure results a member of the Onygenales, an order specialized in keratin degradation. Its presence in faeces is explained by the fact that keratin, in the form of a thin cytoskeleton net, is present in all mammals epithelial cells including the gut mucosae. The fact that horns get thinner at every use suggests a catalytic connection between the main representative of the manure fungal community and the horn's composition. The dominance of a fungus with a tight ecological attitude, i.e. the capability of digesting keratin, suggests that horns, qualify as substrates for a specific proteolytic decomposition process which is bound to drive the series of bacterial and fungal

succession which is observed to occur across the whole process.

Conclusion

Being keratin also the polymer by which horns are totally made of, a rational ground is suggested to the hitherto unexplained practice of placing manure into horns.

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Keywords

Biodynamics, hornmanure, onygenales, keratinolysis

Farm Individuality and Compost

Biodynamic compost effect on soil parameters in a long-term field experiment

Dr. sc. agr. Heberto Antonio Rodas Gaitán[1], *Jürgen Fritz[1]*

[1]University of Kassel, Organic Farming and Cropping Systems, Witzenhausen, Germany,
heberto.rodas@yahoo.com

Composted farmyard manure (FYM) is mainly used in organic agriculture for soil quality enhancement. The aim of the present work was to point out the role of traditionally and biodynamically composted FYM on soil parameters in a long-term field experiment, where different FYM has been applied during 27 years.

The initial soil had low potassium contents. Field experiment is located on the Wiesengut certified organic research farm of the Institute of Organic Agriculture, University of Bonn. Experiment was carried out under a completely randomized block design considering four treatments: T1 (without FYM), T2 (FYM), T3 (FYM+ biodynamic Achillea preparation), and T4 (FYM+ all biodynamic compost preparations) with six replications and applying 30 ton fresh mass ha-1 year-1. Rotation of six main crops was identical among all 24 plots.
Laboratory analyses were: General soil analyses: Dry mass, pH, carbonate, total C and N, soil organic carbon. Soil biology: Basal respiration, microbial biomass C (MBC) and N (MBN), ergosterol, multi substrate-induced respiration (MSIR). Soil physics: Water retention curves, infiltration, air-water conductivity, water holding capacity, aggregate stability, bulk density, contact angle, texture. Spade Analysis (SPA): Scoring categories for aggregates, roots development, pores, color and drop shatter test for top- (0-15 cm) and bottom layer (15-30). The highest values of total soil C and N were found in T2 and T3.

However, significantly more MBC and MBN were found in T3 (FYM+ biodynamic Achillea preparation). Through MSIR, after applying 18 different substrates to soil samples, respiratory responses from 14 substrates showed the significantly highest values in treatments with all BP or with 502. The highest multi-substrate-induced respiration rates in T3 and T4 are an indication of high soil microbial activity. T1 showed a low respiration rate. Regarding SPA, the highest significant mean was found in T4 for -roots development- of the top layer, whereas means for most quality visual parameters showed the following order: T4>T3>T2>T1.

The use of FYM and also biodynamic compost preparations in FYM promoted soil microbial activity, improvement of soil physical properties, and water retention.

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term field experiment. Biology and fertility of soils, 40(4), 222-229.

Keywords

Biodynamic agriculture; achillea preparation; multi substrate-induced respiration; spade analysis; microbial biomass

Grasping the Whole – Biodynamic Tacit Knowledge

PhD Sofi Gerber[1]

[1]Skillebyholm Biodynamic Education Centre, Research, sofi.gerber@skillebyholm.com

How do biodynamic farmers experience, conceptualise and develop their farm's individuality?
From a Goethean perspective, the whole is more than the sum of the parts. It is something in its own, but since the whole is not a thing, it is often difficult to grasp and express.
From a reductionist scientific perspective, the holistic aspects are often overseen. This has also been the case in much of the research on biodynamic practices.

My research investigates how biodynamic farmers in Sweden relate to the farm individuality in their daily work. Through semi-structured interviews, participant observations of daily work (shadowing) and walk-and-talk conversations, I examine the tacit knowledge developed by the farmer in relation to his/her farm. In working with the living, the biodynamic farmer is in a process of coming into being. This process takes place on different levels at the same time, including the observation of a single plant while harvesting it, reflecting on how it was planted and if it should be done differently and constant adjustment of compost and biodynamic preparations practices.

This leads to farmer self-reflection on her/his own knowledge in relation to the development of their farm. In their daily work, the farmers move upstream and downstream in time, e.g. when holding a small lettuce seed and in the moment of seeding it seeing themselves selling that luscious lettuce head to a customer at the summer market. This kind of imagination is not only abstract but is developed through practical work throughout the years. The experiences from earlier seasons nourish the imaginative forces. Biodynamic farming is a hermeneutic process in which the farmer moves between parts, from the bigger picture of grazing and crop rotation down to details of routine daily work.

These observations lead to adjustments in understanding the whole, which in turn put the details in a new perspective. But, unlike a hermeneutic text analysis where the analysed object is at hand, the farmer is co-creating the wholeness – the farm individuality – that he/she relates to. In that sense, farming practice contains both reflexive and imaginative aspects, even though these are often tacit and not explicitly articulated.

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Keywords

Biodynamic farming, farm individuality, tacit knowledge, Goethean science, hermeneutic circle

Research Methodology

A single case study into research methodology: Opportunities and limitations of a long-term randomized field experiment to investigate the possibility of replacing animal manure with plant manure in biodynamic farming

***Cornelius Straesser*[1], *Christopher Brock*[2], *Claudia Scherr*[3], *Julia Wright*[4]**

[1]*Software AG - Stiftung, Am Eichwäldchen 6, 64297 Darmstadt, Deutschland, c.straesser@sagst.de*

[2]*Forschungsring für biologisch-dynamische Wirtschaftsweise e.V. Brandschneise 5 64295 Darmstadt, Germany*

[3]*Society for Cancer Research, Kirschweg 9, CH-4144 Arlesheim, Switzerland*

[4]*Centre for Agroecology, Water and Resilience (CAWR), Coventry University, Ryton Organic Gardens, Coventry CV8 3LG, UK*

A wide variety of research methods are used in research on BD agriculture, in order to investigate the productivity, self-regulation and sustainability on a farm as well as product quality. Additionally, BD agriculture aims at more comprehensive effects on various levels like sustainability for the environment, climate and humans; health of plants and animals; development of a farm organism as self-contained as possible; nourishment of humans for body, life, soul and spirit; care and promotion of natural beings; enlivening of the earth/the soil ; permeating the manure / the the soil with reason and intelligence; empowerment and development of the farm´s individuality; …

So far, there are hardly any publications on which research methods are suitable under which circumstances to answer the different questions arising from BD agriculture.

Based on the detailed experimental design of the long-term experiment "BoDyn", which was initiated on the farm Oberfeld near Darmstadt, DE in 2018, the methodological approach, the possible conclusions as well as the emerging questions are described.

Thereby, a cyclical process of viewpoints is run through, which can be called "research logic“:

1. Questions and hypotheses
2. Data collection, parameters
3. Data analysis, statistics
4. Possible results
5. Achievable statements
6. Discussion of results and statements
7. Emerging questions

On this basis, the strengths and limitations of the methods applied at the long-term randomized field experiment are identified for answering questions on the different levels at which BD agriculture aims; methods like measurements of soil organic matter, nutrient availability and losses, soil structure and moisture, biological activity, microbial diversity, plant health, crop yields and product quality as well as statistical analysis of the data.

This case study can also be used to elucidate, via the statements for the individual case, that applying such a research logic for developing an experimental design can lead to a clearer awareness of the possibilities and limitations in relation to the questions

asked. This can contribute to more refined research outcomes and better use of human and financial resources, as well as promote a focus on the core questions of BD agriculture. As an outlook, the perspective is presented that an overview may emerge from a larger number of such methodological single case studies on BD research projects, which could become the basis for the participatory development of a research strategy on BD agriculture.

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Keywords

Research logic; longterm field experiment; methodology; single case study

Influence of different cultivation methods on the bacterial diversity in vegetables and the influence of consuming these vegetables on the GI-tract

Iris van Zoelen[1]

[1]Maastricht University, Centre for Healthy Eating and Food Innovation, iris.vanzoelen@outlook.com

Background
A low gut microbial (GM) diversity is associated with various diseases, including metabolic and inflammatory disorders. To maintain a high GM diversity, diet is of crucial importance: a complex and varied diet rich in fibers is associated with a relatively higher GM diversity.
The reduced use of herbicides and pesticides is associated with a higher microbial diversity in soil.
A study on apples has shown that cultivation in a highly diverse microbial environment results in an increased diversity of microorganisms within this fruit.

Research question
Does consuming vegetables with a high microbial diversity (obtained by cultivation in soil with a high microbial diversity) or with a low microbial diversity (obtained by cultivation in microbial soil with a low diversity) result in differences in microbiota diversity in a model system of the small intestine of humans?

Research methods
To study this, the diversity of the microbiota within cucumbers, lettuce, bell pepper and tomatoes cultivated in a greenhouse will be compared to the counterparts cultivated outside in soil with no use of synthetic pesticides and herbicides. This will be investigated in a sophisticated, validated model of the upper GI-tract: the TNO in-vitro Model of the stomach and small intestine (TIM-1) using a parallel group design. A puree will be made from 200 grams of product. Fifty grams will be sampled for bacterial microbiota profiling by 16S-rRNA gene amplicon sequencing. The other 150 g of product will be added to TIM-1. At the end of TIM-1 the total efflux will be collected and sequenced using 16S-rRNA gene profiling to evaluate composition and diversity of the bacterial GM. Alpha diversity of the samples, based on Shannon and other diversity indices, will be measured. The beta-diversity will be determined by the use of QIIME2. The non-parametric Kruskal-Wallis test (with FDR correction) will be used to determine the

significant differences on taxa abundance at genus level and in some cases, species level.

Results

The results of this study will be obtained at the end of June 2021. The results will include microbial diversity of four different vegetables cultivated in an environment high or low in microbial diversity, including the difference within product groups. The second part of this study will show the diversity of the bacterial population in the small intestine, simulated by a TIM-1, after digestion of the vegetables.

Conclusion

Based on findings in the relevant literature we expect a higher diversity of microorganisms in the vegetables cultivated in a high microbial divers environment compared to vegetables cultivated in a low microbial divers environment. In addition, differences will be evaluated between these products when digested in TIM-1 in order to conclude about the influence of the digestion from mouth to ileum, on the composition and diversity of bacterial GM and the implications for human health.

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Keywords

Human, health, gut, microorganisms, diversity

Kinesthetic engagement in the visual evaluation of copper chloride crystallization images

***Paul Doesburg*[1],** *Jürgen Fritz*[2] *, Roya Bornhütter*[3]*, Uwe Geier*[3]*, Gaby Mergardt*[2]*, Claudia Scherr*[4]*, Nicolaas Buscher*[2]*, Miriam Athmann*[2]

[1]*Verein fuer Krebsforschung, Pharmaceutical Processes, p.doesburg@vfk.ch*

[2]*Department of Organic Farming and Cropping Systems, University of Kassel, Nordbahnhofstr. 1a, D-37213 Witzenhausen, Germany*

[3]*Forschungsring e.V., Brandschneise 5, D-64295 Darmstadt, Germany*

[4]*Society for Cancer Research, Kirschweg 9, CH-4144 Arlesheim, Switzerland*

There is an increasing interest in a systemic approach to food quality. From this perspective, the copper chloride crystallization method is an interesting asset as it enables an estimation of a sample's 'resilience' in response to controlled degradation.

In previous studies, we showed that an ISO-standardized visual evaluation panel could correctly rank crystallization images of diverse agricultural products according to their degree of induced degradation.

In the current study, we examined the role of contextual sensitivity herein, with the aim to further improve the visual evaluation. To this end, we compared subjects' performance in ranking tests, while primed according to two perceptional strategies (levels: analytical vs. kinaesthetic engagement), according to a within-subject design.

Kinaesthetic engagement in crystallization image evaluation involves an embodied simulation of the growth, curvature and tension of the tree-like branches of the crystallization images. The ranking test consisted out of wheat and rocket lettuce crystallization images, exhibiting four levels of induced degradation.

The perceptual strategy imbuing kinaesthetic engagement significantly improved the performance of the ranking test in both samples tested. The outcome demonstrates the significance of an empathetic engagement in the visual evaluation of crystallisation images. This forms a conceptual basis for a qualitative discrimination of crystallisation images of products derived from different farming systems.

References

Huber et al,. 2010
Doesburg et al., 2014;
Frtiz et al., 2018
Busscher et al., 2014
Doesburg et al., 2021

Keywords

Copper chloride crystallisation, visual evaluation, kinesthetic engagement, panel training

MILK PRODUCTION AND PROCESSING

Innovation culture in biodynamic practice on the example of mother bound calf rearing systems in Germany

Dr. Daniel Kusche[1], *Kühnemann Alina[2], Simantke, Christel[3]*

[1]Kassel University, AG Biodynamic Agriculture, daniel.kusche@uni-kassel.de

[2]Kassel University, Faculty of Organic Agricultural Sciences, Germany, Section of Organic Farming and Cropping Systems

[3]Kassel University, Faculty of Organic Agricultural Sciences, Germany, Section of Farm Animal Behavior and Husbandry

In Germany, organic farmers with innovative and forward-looking ideas can apply for the federal organic farming competition. Individual concepts that have proven themselves in practice are sought. These concepts can encompass the entire farm or cover individual areas. All farms that have been certified organic for at least two years in accordance with EU legislation on organic farming are eligible to participate. The prerequisite is that the entire farm is managed organically (oekolandbau.de, 2021). Jury board member of the federal organic farming competition Prof. J. Heß (2020) had the assumption that particularly many biodynamic farms were among the prizewinners of the competition in the last 20 years until 2020. This assumption could been verified based on the data on prizewinners of the competition. As a result, it turned out that out of 60 organically operating prize-winning farms, 19 farms belong to the Demeter association and this, although the share of Demeter farms of all organically operating farms in Germany is nowadays only approx. 5 %.

This factual situation gave rise to the following questions: What conditions prevail on biodynamic farms that make them so innovative in comparison to other certified organic farms? If and why the Demeter association seems to be instrumental in establishing and developing such an innovation phenomenon? What moves biodynamic farms to the topic and how did this innovation development come about on the farms?

In order to find indications for the innovativeness of biodynamic farms, the 19 Demeter awardees of the competition were examined with the help of a more detailed categorization by means of given information in the form of text and film on the website of the competition. It was noticed that 5 of the 8 Demeter dairy farms in the competition practice mother bound calf rearing in one or the other form. Mother bound calf rearing systems can be described as an innovation phenomenon. Frams using this system are not officially counted. Only an estimated share below 0.5 % of all dairy farms in Germany practice it today, but it has become well known in recent years. Biodynamic farms were among the first to establish and develop this new system and are still leading the introduction in broader agricultural practice. In October 2019, we additionally observed the introduction of a first label of biodynamic hay milk farmers on the market that included mother bound calf rearing systems.

2 of the 5 prize-winning biodynamic farms in the competition that practice mother bound calf rearing were interviewed about their specific background and the introduction of their new calf rearing system. Due to the Covid restrictions to that time, the planned farm visits could not take place and telephone interviews were conducted using the guided interview method.

After addressing both farms own individual systems of mother bound calf rearing, the findings were that farm-specific implementation determines the success of the system. A look on other farms practicing other variations of mother bound calf rearing systems showed that there is no such thing as the one standard system. Rather, the interviews showed that those systems are still being further developed and that real pioneering work is being done on the farms. This new form of calf rearing on both farms convinced the farmers with more advantages than disadvantages. Neither of the farms would like to imagine returning to the old calf bucket feeding.

An allocation of 8 factors according to Augsten et al. (2017) attributed special innovation potential to both farms. After qualitative content analysis according to Mayring (2010) of the interviews and an evaluation of the personalities of the innovators, it can be concluded that the Demeter association with its mission statement and guidelines did not provide the impetus for innovation in the case of the mother bound calf rearing on both of the prize winning farms. The idea of feeding calves by their mothers at the time of the first practical introduction on the farms was just as new and unconventional to biodynamic advisors. However, the Demeter association seems to attract people and personalities who are inclined to self-critical questioning, have high demands on agriculture, which are always compared with the real practice/situation on the farm. The practitioners needed courage as well as willpower, even against resistance or concerns from the outside, to introduce the new system. Severe calf diarrhea as well as critical questions from customers why calves are separated from their mothers were additional impulses in the two selected case studies to enter into the change process and the beginning of giving back the cow and her calf the relationship appropriate to their nature.

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Keywords

Innovation, mother bound calf rearing

Can milk consumption impact resilience, how and what milk?

Ton Baars[1], *Johan Garssen Same*

[1]Utrecht University, Department Immunpharmacology, a.baars@uu.nl

Introduction

Food processing, - quality, and - origin impact our health. What is known about Hippocrates' statement *'led food be thy medicine and medicine be thy food'* with the focus on milk? Goal of this article is to discuss, how milk can be part of a healthy diet; what kind of milk quality is found in relation to health support and how this insight impacts organic and biodynamic milk production.

Milk and health

Milk has become a food commodity and there is a constant pressure on the price of milk. Price competition led to an ongoing intensification of production per cow, per hectare land, per farm and per farmer. Farm milk nowadays is chilled in bulk tanks for 2–3 days, transported over large distances to be processed in large scale plants. Milk has become raw material for processed foods. The obliged pasteurization of farm milk in European countries is prompted by food safety issues and the increase of the shelf life of heated milk.

At start of the millennium the negative health impact of the heat processing of milk was recognized. In the last two decades a wide range of studies showed, that:

- The protection was found in farm children as well as in urban children, if they consumed raw cow milk since the first year of life (Braun-Fahrländer et al., 2011; Brick et al., 2020).
- Whey proteins, and especially unchanged beta-lactoglobulin excreted in the cow's environment (urine) and in raw milk play an essential role in the immunology (Roth-Walter et al., 2020).
- Cow milk tested in mice models confirmed the impact of heating: only after heating of either raw milk, skim milk or whey a negative immune response was found (Abbring et al., 2019; 2020).
- In mice, there was already a cut-off in the allergy outcomes, when milk was heated above 60^{o}C (Abbring et al., 2020).
- The incidence of asthma in pre-school children was reduced, if children consumed pasteurized milk products, full fat milk or butter, but not skimmed milk and margarine (Wijga et al., 2003).
- A reduced incidence of allergies and asthma was found in relation to specific fatty acids in milk, omega-3 fatty acids and/or CLAc9t11 and its precursors (Kummeling et al., 2008; Brick et al., 2016).

Resilient farming and robust human health

The two ways to impact immunity (through raw milk or the fat plus fatty acids) have different impact on milk quality. To get high levels of long-chain poly-unsaturated fatty acid in milk fat, the cows need to produce milk from grass, avoid maize silage and concentrates (Baars et al., 2019-A). Most milk should be produced in summer, and surpluses in summer will be preserved in terms of cheese and butter.

The other route of protection lies in safely produced raw milk or raw fermented drinking milk, like kefir (Baars et al., 2019-B; Baars, unpublished data). To reduce the zoonotic risks, the industrial challenge is based on high-tech milk processing based on ultra-filtration, high pressure and UV-light to eliminate bacteria, so-called less-processed milk (Zhang et al., 2021). The farmer's task to reach a resilient raw milk production is through knowledge about the safe on-farm production of raw milk, germ ecology and grass-based systems (Berge et al., 2020).

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Keywords

Raw milk, milk quality, immunity, prevention strategy

CHROMATOGRAPHY

Correlations between Pfeiffer´s circular chromatography test and physical, chemical, biological compost parameters in compost and vermicompost

***Lissette Alejandra Pérez Alvarez*[1], *Orlando Vielman-Ruiz*[1], *Heberto Rodas-Gaitán*[2]**

[1]*Universidad de San Carlos de Guatemala, Faculty of Agronomy, Guatemala. Contact: lissale17may@gmail.com*

[2]*Universität Kassel, Organic Agricultural Sciences/ Organic Farming and Cropping Systems, Witzenhausen, Germany*

The objective of the present work was to evaluate the quality of compost (Exp 1) and vermicompost (Exp 2) by chemical (electrical conductivity -EC-, pH, ash content -AC-, organic matter -OM-, N, C, H), physical (temperature, moisture, volume, color) and biological analyses (CFU of fungi, bacteria), and looking for correlations between them and data obtained from visual inspections of chromatograms (VIC) of both experiments. Experiments were carried out at the Faculty of Agronomy (UANL, Mexico).

Exp 1 was established under a completely randomized design with factorial arrangement: two turning frequencies (once every 7 and 14 days) and five substrate mixtures (moringa crop wastes –MW-; cow manure -CM-).
Exp 2 was carried out with the same statistical design considering two earthworm species (Eisenia foetida and E. andrei) and four substrate mixtures (MW; CM; chicken manure -CHM-; cafeteria wastes -CW-). Three replications were considered for each treatment.
Data collected from VIC were: zones (dist), concentric rings, color, channels, and spikes. VIC and chemical-, physical-, biological -parameters (CPBP) were subjected to ANOVA or by non-parametric tests (according to assumptions). Pearson correlation coefficient (r) was considered in order to determine the correlation degree between all parameters obtained from VIC and CPBP.
Highlights of experiments: (1) Turning compost every 14 days had the significant highest N retention, but the lowest significant OM. Increasing CM amounts in compost mixtures attained a significantly lower C:N ratio at the end of the experiment, which may promote a better substrates decomposition. (2) CFU of bacteria were significantly highest in treatments with E. foetida. The same specie in MW:CM:CW mixture (1:1:0.5 ratio) showed the highest significant values of AC, OM, and moisture. pH values were significantly higher in treatments without CHM.
Significant correlations were found between VIC and CPBP. However, variables correlated differently in each experiment.
In Exp 1, OM and EC correlated negatively with the middle and outer zone, as well as channels and spikes with CFU of bacteria and fungi. Moisture created positive correlations with the outer zone, as well as pH with the middle zone.
In Exp 2, OM and moisture correlated positively with the inner zone, channels, and spikes, as well as EC with the inner zone. Significantly negative correlations were found between CFU of fungi and middle zone, as well as pH with channels and spikes.

Further studies on correlations between picture elements in PCC and CPBP are necessary for further development of PCC as a method for assessing compost.

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Keywords

Organic agriculture, Eisenia foetida, Eisenia andrei, substrate mixtures, pearson correlation

Farmers ability to perceive soil health using circular chromatography

Liron Israely[1]

[1]Adama Haya, liron@adama-biodynamics.com

Global food production depends on soil health (SH). The search for an all-inclusive indicator for SH is challenging deductive scientific research, as SH should derive from the interrelation of physical, chemical, and biological components. This complexity of SH indicators is a barrier for farmers with practice orientation. Lack of coherent understanding of overall soil conditions is tampering with practitioners' choice of best practices promoting SH.

The Pfeiffer's circular chromatography (PCC) has been reported to generate a qualitative SH assessment. PCC Visual representation of SH is suggested to be accessible for the nonscientific community via a non-numeric reading. To date, PCC research work investigated its ability to report on SH or specific soil conditions. When reviewing the original design of PCC, it is evident that its full potential should lay in the meeting point between the farmer and their ability to perceive the soil condition.

This pilot research aims to map the relationship between agricultural practices and PCC results. Furthermore, to shed light on farmer's reaction to the qualitative indications derived from PCC.

As part of farm consultation work, 10 farms in Israel were monitored in the Mediterranean, semi-arid, and hipper desert zones. Their cultivation includes vegetables, olive groves, vineyards, and almonds. Farming practices observed: with\without cover crops, changes in soil cultivation, and biological amendments of biodynamic preparation, compost tea, and effective micro-organism (EM).

Using an Archetypal Mapping method, the research was able to identify key visual changes in the chromatography correlating

between the different agricultural practices. Thus, it is possible to indicate how PCC represents soil care practices. Farmer's perspective of the PCC results were decoded using ground-based theory methodology.
4 levels of soil health understanding were identified. Motivation for choosing practices promoting soil health were noted.

The interim conclusion of this ongoing action research reveals the possibilities laying in a non-numeric understanding of SH. When done with farmers' direct reporting on their understanding of SH, the PCC could be an important tool for promoting best practices.

Further investigation is needed to develop archetypal mapping of chromatography results. Long-term monitoring and farmer reporting on their understanding of SH will continue to improve the processes leading to SH adoption.

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Keywords

Soil health, chromatography, Soil assessment, Qualitative assessment

System Comparison

Do biodynamic preparations influence yields, product and soil quality? Evidence from 15 years of research in the Frick long-term trial, Switzerland

Maike Krauss[1], *Meike Grosse[1], Paul Mäder[1],*

[1]FiBL, Ackerstrasse 113, 5070 Frick , Soil Science Department, Contact: maike.krauss@fibl.org

Research question
Do biodynamic preparations (500-507) influence yields, product and soil quality in a Swiss arable rotation in the long-term?

Research method(s)
The Frick trial (47°30'N, 8°01'E, 350 m a.s.l.) was started in 2002 and has a factorial strip split-plot design representing the bioorganic and biodynamic farming systems separated for fertilisation (slurry vs. manure compost/ slurry, one livestock unit nitrogen per ha) and biodynamic preparations (with BD500-507 vs. without) in split-plots.

The crop rotation includes winter wheat, silage maize, spelt and two years of grass-clover. The rotation was adapted to the heavy clay soil (45% clay) and moist cool climate conditions (1044 mm, 10.3°C). See Krauss et al. (2020) for more details.

In each year, yields and nutrient contents of plants and manures were measured. Soil quality analyses were conducted in three-year intervals in 0-10 and 10-20 cm soil layers. They included chemical (pH, soil organic carbon, nutrients) and biological (microbial biomass and activity) parameters.

In addition, product quality of wheat was assessed in 2003, 2009 and 2019 by biocrystallisation (CuCl2) with the focus on samples with and without biodynamic preparations.

Results
Over the course of 15 years, the application of biodynamic preparations did not impact yields in comparison with non-treated plots (Krauss et al. 2020). We detected some effects on soil quality in some years, which however did not lead into an overall trend over time.

In 2015, plots with biodynamic preparations induced a lower soil pH. In the last sampling in 2018, ca. 5% lower microbial biomass and 6% lower P contents were recorded. The assessment of wheat grain quality with CuCl2 biocrystallisation revealed a correct separation of blinded samples treated with and without biodynamic preparations in 2003, but not anymore in 2009 and 2019.
In an extended assay in 2019, the fertilization treatment were discerned. The addition of manure compost also increased soil quality over time while yields were slightly lower than in the slurry only fertilization treatment.

Conclusion
In the arable farming setting of the long-term trial in Frick where the bioorganic and biodynamic farming system was compared in a factorial design, only minor impacts of biodynamic preparations were recorded.

Fertilization on the other hand had a consistent impact and may indicate that it is

more the addition of manure compost that improves soil quality and impacts yield and yield quality than biodynamic preparations.

There is also the question, if the influence of biodynamic preparations can be assessed in field trials with plot replicates following natural science based standards as we have seen effects in the beginning diminishing with time.

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Keywords

Arable farming, long-term trial, biodynamic preparations, fertilization

South African farming systems research comparing organic and conventional: The Mandela Trials.

Dr. Raymond Auerbach[1]

[1]Nelson Mandela University, Agricultural management, raymond.auerbach@mandela.ac.za

The Mandela Organic Farming Systems Research Trials compared organic and conventional farming with cabbages, sweet potatoes and cowpeas in rotation and also with mono-cropped cabbages.

In the first two years, soil life improved and soil acidity decreased in the organic treatments; however, the yield gap was larger after the second year (organic 31% lower yields) than the first (20%). Low available soil phosphate was then addressed using rock phosphate before planting the third cycle of crops. The yield gap was closed after the third year, with organic crops outyielding conventional.

A wide range of soil improvements was measured, including soil micro-organisms (diversity and quantity), soil organic carbon, soil water content and soil chemistry. Soil water content was consistently better in the organic farming system, as was soil organic matter and soil acidity.

In the fourth year, crop rotation yields were significantly better than mono-cropped cabbage yields. Sensitive chromatography showed improved soil structural patterns and a more alive picture for organic soils than conventional.

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Keywords

Soil biodiversity; farming systems comparison; soil organic matter.

CERTIFICATION

Alternative certification paving the way to social innovation

Dr. Daniel Kusche[1], *Vera Müller[2], Christian Herzig[2],*

[1]Kassel University, Faculty of Organic Agricultural Sciences, daniel.kusche@uni-kassel.de

[2]Kassel University, Faculty of Organic Agricultural Sciences, Section of Management in the International Food Industry Steinstr. 19, 37213 Witzenhausen Germany

The organic sector is looking back on a story of success. Starting in small alternative circles, the last decade has proven how professionalized alternative food systems can be. Alongside this professionalization, a complex certification system has evolved in order to guarantee an agreed minimum of organic practice.

In the European Union, the process started with the development of an organic regulation in the beginning of the 1990s. A farmer 's compliance to these standards is ensured by private certification bodies, which compete with other certification bodies. Until today, the organic quality of a certain farm's products is determined by a regular farm audit through a trained inspector.

The biodynamic association in Germany has developed the concept of development-oriented certification, which aims at centering the certification process on the individual development of the biodynamic farm. The participatory mode of the certification procedure aims to go beyond regulatory compliance and encourages innovation and individual value orientation.
The concept is both referring back to the beginnings of organic agriculture, preserving original ideals and values and it is going forward in the way that every farm is supported in its individual path of development towards sustainable organic farming.

In the ongoing pilot project approximately 40 farms are trialling the development-oriented concept. Central to the development of this pilot project was the idea to both strengthen value orientation and the opportunity for individual development within the certification process, acknowledging that the idea of biodynamic farming consists of more than complying with standards.

Hence, the research question is: Does the new concept of development-oriented farming allow for more value orientation, cooperation, and innovation in the certification process?

The group certification process has been documented as a case study of participatory certification in Germany. Three German biodynamic farms have been accompanied in their development-oriented certification process in the year of 2019. Additionally, two expert interviews with a certification expert and an agricultural advisor illustrate the debate on the necessity for progression within the organic certification sector. The certification process observation and the interviews were conducted by one researcher. The interviews were based on a partly structured interview guideline and held via telephone; the process observation was conducted on the respective farms. Data was recorded and transcribed for later analysis.

The interviews show a broad spectrum of perspectives on organic certification. Third-Party Certification (TPC) has become a

complex and technical process, that allows full confidence of consumers in the organic quality of the produce. For organic producers, the certification process is part of yet another requirement of red tape.

The concept of development-oriented certification has been developed by a working group within the Demeter Germany association. With approval of the Demeter International board, up to 100 farms are eligible to take part in a pilot project which lasts for 5 years (2018-2022). For the time of the project, the regular Demeter audit by a certification body is suspended. The certification procedure is described in a corresponding handbook. Facilitators have been trained accordingly by the project team. The participating farms are allocated in so-called credit groups of three to five farms each. Central to the procedure is a farm development dialogue which consists of a facilitated group discussion on the respective farm. Farmers of the credit group as well as the group's own facilitator are part of the dialogue. The facilitator moderates the process for the whole group. The structured group discussion lasts about four hours. The farm development dialogue takes place once a year at each farm. This means the development-oriented certification process is not necessarily more time efficient than the regular third-party certification. It is, however, more personalized adapted to the individual farm and its key issues. Each year, every farm defines two to three development measurable goals. These goals can refer to economic achievements, social changes, ecological ideals, or milestones for the development of a new branch of the farm. At the end of the dialogue, the facilitator and other farmers discuss whether the respective farm will be granted the Demeter certification. If there are serious doubts, individual action plans are to be designed by the group and checked back with the respective regional office. The sovereignty over the development-oriented certification process lies mainly within the group and can be adapted according to individual needs. The space that is provided by a new understanding of certification – a type of peer-to-peer-certification – can create a common grounding among the respective farmers.

In response to the research questions, the following developments could be observed: the participatory certification stimulates the group members' reflection on their value orientation. This not only bears the potential for holistic farm development and innovation, but also brings members of biodynamic farming to tell their personal biodynamic story. However, as this is an official certification process, all members have economic and social interests in a successful certification process and are, at the same time, designers of that very process. Theories of commoning and collective action confirm that these are preconditions for effective social innovation.

Additionally, the group members strengthen the relationships themselves through involving each other in the individual farm development. There are, however, risks of principal-agent-problems as well as potential loss of consumers' trust.

The risks and chances need to be investigated further during the course of the pilot project, since the development-oriented concept is equally remarkable and ambitious. Demeter is going down a courageous path with the trial of bottom-up participatory certification, aiming to connect the dots of the movement's beginnings and its future.

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Keywords

Development-oriented certification; organic and biodynamic agriculture;

BioFarming and BioHotels Perspectives in Georgia

President Kakha NADIRADZE[2], *Mrs. Nana PHIROSMANASHVILI[2]*

1AFRD Georgia, BioFarming, nadiradzekakha@gmail.com

[2]Executive Director AFRD Georgia, Ms. Tekla NADIRADZE Young Researcher - AFRD Georgia

Nowadays the BIO farming is the best method for healthy and organic food which takes an important role in sustainable and environmentally friendly agricultural and food production in Georgia.

The paper analyzes the development and issues of future perspectives of Bio (organic) farming and BioHotesl Businesses in Georgia.

Some findings of organic agriculture development are given, estimating the primary information on organic farming in Georgia regarding the trends of the organic farms' number, utilized organic agricultural, and share of organic land in the total agricultural land.

The influence of Georgia's Bio Farmers will be increased in coming years and some issues of further perspectives of the development of Georgian BioHotesl Facilities will be integrated with BioFarmers and organic Food Producers.

Because bio-certification is quite expensive for Georgian farmers, our association helps local bio-farmers to learn more about bio-hotels philosophy and Business Models to be able to feed their own guests with their own bioproducts, and this is the best way for them to earn extra income.

Keywords

Climate change, biodiversity, biofarming, Georgia, BioHotels, income

Breeding and Selection

Breeding for nutritional quality in open pollinated vegetable crops

Dr. Edwin Nuijten[1]

[1]De Beersche Hoeve, Oostelbeers, the Netherlands, e.nuijten@debeerschehoeve.nl

After decades of focusing on increasing crop yield, improving nutritional quality of food crops is gradually becoming more important in plant breeding. In particular organic consumers value the nutritional quality and taste of food. However, it is not yet clearly understood how breeding can improve the nutritional quality of food crops. There is evidence that in general breeding can result in lower mineral contents (Murphy et al. 2008; Davis, 2011). It is also suggested that it is possible to aim for a balance in yield and nutrient quality in wheat (Moreira-Ascarrunz et al. 2016). In that respect, not much scientific evidence exists in the case of vegetable crops, although there are interesting studies. For example, Renaud et al. (2014) studied the complex relationships between specific secondary metabolites of broccoli cultivars under organic and conventional conditions.

However, in biodynamic breeding the aim is to breed for nutritional quality from a holistic perspective. An important question is how plant breeding with a focus on traits to improve aspects such as storability and increased harvesting efficiency may have impacted nutritional quality and taste. Another important question is how to select for improved nutritional quality and taste by looking at plant growth and more specific traits like leaf formation, shape and size. A better understanding of such relationships will allow indirect selection in the field.

An overview has been made on various crops using different methods (field observations, taste tests, and various laboratory analysis (see Table 1). For example, in the case of cauliflower and Chinese cabbage, negative relationships were found between leaf formation and taste. For red cabbage, relationships between leaf development and picture forming methods were observed. Comparisons on onion and pumpkin showed that soil fertility and soil type can have large effects on nutritional quality and are often interacting with different cultivars of these crops.

Nevertheless, these comparisons suggest that there are relationships between plant growth and nutritional quality. This means that farmer breeders can select for nutritional quality by selecting on specific plant growths. The data show that for each of the studied crops different approaches are needed to address nutritional quality in the breeding process.

Table 1: Data collection on various crops was conducted in the following projects in the following locations and years. Per crop a brief description of the focus of the main results is provided.

Project	Location *	Year	Crop	Main results
Diversen Dichtbij	GAOS	2014/15	Red Cabbage	Relationships between leaf development, nutritional quality and picture forming methods were observed
Breeding for quality	GAOS, DBH	20`17-2018	Carrot, Red Cabbage, Pumpkin	Relationships between yield, storability, taste and nutritional quality
LIVESEED	DBH	2019	Cauliflower	Leaf formation and taste
Zaadvasten Zeker	DBH	2020	Chinese Cabbage	Leaf formation and taste
Zaadvasten Zeker	GAOS	2020	Onion	Yield, storability and nutritional quality
Zaadvasten Zeker	DBH	2020	Pumpkin	Relationships between yield, storability, taste and nutritional quality
Zaadvasten Zeker	DBH	2020	Rucola	Yield, leaf development, taste and nutritional quality
Zaadvasten Zeker	DBH	2020	Spinach	Yield, leaf development, and nutritional quality
Zaadvasten Zeker	DBH	2020	Red Beet	Yield, leaf development, and betacyanin levels

* the farm GAOS has clayey soil, the farm DBH (De Beersche Hoeve) has sandy soil.

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Keywords

Plant breeding, vegetables, nutritional quality, indirect selection

Partnership breeding of maize for nitrogen efficiency/fixation, weed control, and nutritional value.

***Walter Goldstein*[1], *James White*[2]**

[1]*Mandaamin Institute, Inc., Research, wgoldstein@mandaamin.org*

[2]*Rutgers University Dept. of Biology, New Jersey, USA. jwhite3728@gmail.com*

Question

How to evolve maize to increase sustainability and resilience for farming and thereby to marry it with a future that is healthier for humans and the planet?

Methods

The program uses pedigree breeding and yield testing, but its philosophy is to dialogue with maize as a biologically creative partner. Aside from orchestrating genetic recombinations, our breeding process also involves observing and utilizing shifts in regulatory patterns that may be epigenetically engendered or caused by genomic shifts ('emergence-breeding'). To increase its resiliency, and induce shifts, maize was grown and selected under biodynamic/organic environments that featured stress from limitations of nitrogen (N) and weeds.

Results

Spontaneous mutations and heritable changes were employed to increase essential amino acids and micronutrients in the grain of our corn and nitrogen (N) efficiency. N efficient inbreds were shown to bear bacterial endophytes in their seed, transfer them to their roots, and excrete them through root hairs into their rhizospheres. This process, called rhizophagy, entails the culturing of bacteria and their partial consumption in root cells, and the stimulation by these bacteria of root hair formation. Conventionally bred inbreds, grown under the same conditions, did not foster these bacteria in their seeds and roots. Under N-limited conditions, the putative N2 fixing, rhizophagic inbreds from the Mandaamin program show robust growth as if they have been fertilized with N. Strip trial and small plot trial results showed negative effects of manure applications on grain yields for the putative N2 fixing hybrids but similar or even higher yields to fertilized commercial hybrids if no manure is applied. Some of the putative N2 fixing hybrids seem to better tolerate weed competition. In 2020 hybrid trials took place in a uniform patch of thistle (Cirsium arvense). Yields of the highest yielding putative N2 fixing hybrids in this trial reached up to double the average yield attained with three commercial hybrids from a cooperating organic company.

Conclusion

This partnership breeding is in sync with maize's native cultural roots. The 'partnership' includes positive relationships with microorganisms in plant seeds and roots (rhizophagy). These plant:microbial partnerships enhance sustainability and resilience, including N efficiency and tolerance to weeds, that are not available in conventional maize.

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Keywords

Rhizophagy nitrogen fixation methionine weeds

Agriculture in Brazil

Biodynamic Certification in Brazil

M.Sc. Rayan Scariot Vargas[1], *Andréa Cristina Dorr[1], Jéssica Righi de Oliveira[1], Fernando Silveira Franco[2]*

[1]Federal University of Santa Maria, Department of Agricultural Education and Rural Extension at the Center for Rural Sciences ,Post Graduation Program of Rural Extension, Contact: +55 55 9997-1978 rayan_scariot@hotmail.com

[2] Member of the board of the Brazilian Association of Agricultural Bodinamics and the Brazilian Association of Agroecology. Associate Professor at UFSCAR, Campus Sorocaba. - +55 14 99795-8630 - e-mail: fernando.agrofloresta@gmail.com

The certification process was a legal framework for Biodynamic agriculture, because through this standardization process, the principles first proposed by Steiner for agriculture were legitimized. Through this aegis of legality, the associations and institutes of the biodynamic movement managed to establish themselves and grow in the 20th century, especially after the second world war.

Due to the importance of this recognition, this article pursues to understand the trajectory of Biodynamic certification in Brazil, as well as the institutions linked to the certification process.

A descriptive study was carried out on the certification process, which according to Almeida (1989, p. 71) is characterized by a study that focuses on precise and explicit objectives on the observed facts describing the characteristics of a phenomenon or group of individuals, in the research in question, the agents involved in the certification process, as well as the certifying institutions located in Brazil.

A bibliographic research was also carried out on the subject and semi-structured interviews with agents of the Biodynamic movement in Brazil.

The history of Biodynamics in Brazil is in no way dissociated from the history of the movement started in 1924 by Steiner's agricultural course. The first immigrants to practice Biodynamic agriculture on Brazilian soil were German farmers who left their country of origin in 1939, a time of expansion of the Experimental Circle and full dissemination of Steiner's principles throughout the world, with the creation of associations in several countries.

In Brazil, the audited certification process is 29 years old and is currently carried out by the Biodynamic Certification Institute (IBD), initially created within the Biodynamic movement. Today, the institute moves away from the Biodynamic movement, embracing the different seals that meet the new food trends, acquiring a more entrepreneurial character, and abandoning the principles by which it was founded. The Participatory Guarantee System (PGS), originating from the organic movement, has as diffusers the Association of Biodynamic Agriculture and the Association of Biodynamic Farmers of the South. This system is promising when it merges the legitimacy of the norm with more personal relationships allowing the exchange of knowledge between members, this capacity for exchange of knowledge brings it closer to the roots of the Biodynamic movement.

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Keywords

Biodynamic Certification; Audited System; PGS

Biodynamic Agriculture in Brazil and the relationship with trees and forests

M.Sc. Jéssica Righi de Oliveira[1], *Gisele Martin Guimarães[1], Rayan Scariot Vargas[1], Fernando Silveira Franco[2]*

[1]Federal University of Santa Maria, Department of Agricultural Education and Rural Extension , Postgraduate Program in Rural Extension, Contact: + 55 55 99973-2507 jessica_roliveira93@hotmail.com

[2]Brazilian Association of Agricultural Bodinamics and the Brazilian Association of Agroecology. Associate Professor at UFSCAR, Campus Sorocaba. - +55 14 99795-8630 - e-mail: fernando.agrofloresta@gmail.com

Brazil is a country that, on the one hand, is marked by its wide diversity and forest extensions, on the other, it ends up standing out as a country of large estates, monocultures, forest deforestation and environmental imbalances, these characteristics being the historical results of occupation and land use, driven in the 20th century by a series of unsustainable developmental policies, in various spheres, mainly in the environmental one.

However, observing the biodynamic agricultural organisms in Brazil, the opposite reality is found, in such a way that it was questioned about the contributions that biodynamic farmers in Brazil can offer to the construction of a co-evolution relation between human beings and nature, understood as a necessary aspect for the promotion of sustainable development.

Thus, the object of study of this research were the set of interpretations that biodynamic farmers in Brazil bring in their narratives of the world, with a focus on the meanings and senses that these agents attribute to trees and forests, as well as practices related to.

To this end, a qualitative explanatory research was carried out in 2019, in which, through a phenomenological approach, data was collected from 16 farmers, using tools such as interviews, visits and observations, whose the objective was to apprehend the perception of these farmers in order to demonstrate the importance of the cosmovision of biodynamic agriculture in sustaining an agricultural activity that is harmoniously integrated with nature.

As a result, it was learned that the gaze of the agents in evidence did not allow them to look at the individual tree without thinking about the soil, weather conditions, animal life, etc., demonstrating a thought structure that communicates with Steiner's holistic perception. In this sense, the importance of the arboreal organism lies in its socialization, not necessarily material, with other organisms and factors, making trees important beings in the composition of dynamics and landscapes, making it possible to understand that their presence influences

the energy conditions of agricultural organisms, contributing to their individuality, astrality and quality of life.

It is concluded that the theoretical and empirical reality of biodynamic agriculture in Brazil supports a cosmovision about trees and forests that has much to contribute to the improvement of understanding about development, presenting important experiences as references for the theme and future rural development projects sustainable.

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Keywords

Coevolution; sustainability; rural development; tropical forests

Soil

Soil life quality; gaining first-hand experiences through observational exercises.

Executive Director Walter Goldstein[1], *Mike Biltonen[2]*

[1]Mandaamin Institute, Inc., Research, wgoldstein@mandaamin.org

[2]Know Your Roots, Biodynamic Consultant, Trumansburg, NY, Mike@knowyourroots.com.

Questions are how the life dynamic of the soil can be experienced and characterized and how it is affected by management, monthly rhythms, and regions.

Methods

The potential for having life experience with the soil is assumed as being universally nascent in humans. Participants are recruited from amongst biodynamic practitioners and others. Assistance and outreach are co-sponsored and web information is on the North American Biodynamic Association website. Monthly internet meetings occur to accompany participants.

Participants are asked to individually participate in observing soil from a field or garden that they know the history of and will have access to through the growing season into the next year. The samples should be taken from the same site on a monthly basis, starting in the spring, taking a pause in the winter for frozen ground, and ending with sampling early the next spring. Ideally a heavy feeding crop should be grown. Notes are taken on dates, types of soil, weather conditions, and previous history of the soil in terms of management. Two soil monoliths (approximately 30x30x20 cm deep) are extracted with a shovel and smeared edges are removed to expose native soil structure. The soil profile should be photographed. A short description of experiences should be recorded each month. These include: 1) Outer appearances (including structure, smell, organisms, etc.). 2) Inner life qualities of the soil. 3) A comparison of how the soil has changed between examinations. Ideally, site findings will be gathered in a short PowerPoint presentation with photographs and impressions for consecutive months.

Inner life quality experiences and capacities should develop in the participants by magnifying the genuine life experiences that arise in association with the soil, and participants should find the language to express them. While forming these impressions, observers should abstain from speculation or mixing in information from soil tests.

Guiding preliminary results are that the production of a heavy feeding crop causes a progressive devitalization and degeneration of soil structure until August but that these qualities are replenished in November.

Conclusion

The project is in its second year. The exercise is meant to help participants gain an experiential basis for understanding the second lecture of the Agriculture Course. Reports will enable assessing commonalities in experience and regional differences across the continent.

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Steiner R. Lecture 2. Pages 27 to 43 in: Spiritual Foundations for the Renewal of Agriculture, lectures given in Silesia in 1924, 1993, Published by the Biodynamic Farming and Gardening Association, USA.

Keywords

Human experience life quality soil

Agroecology Value chains and sustainable life cycles

Thierry-Alban Revert[1]

[1]MAGIC Cooperative: Implementation of Municipal Sustainable Development Goals through community cooperatives, The RESTORE program, tar@magicinitiative.com

Preamble
The oral presentation will be an opensource platform to initiate a dialogue towards the creation of innovative cognitive processes and system engineering for "Growing beyond Resilience"

Context
Our study field is spread over the last two decades after the emergence of a "new" democracy in South Africa, observing the concept of property and ownership over land, water, biodiversity, culture and minerals. This originates in the destruction of the paradigm of the "commons" and "cooperation" conducted by traders. soldiers, missionaries and politicians who came in waves to "colonise" and "civilise" the indigenous people. the dominance of the Property over land has become a central issue when it comes to apply associative economics, in local EcoEco Systems and circular ways to consider all inclusive relationships.

Relevance to bio-dynamics and beyond
The field of bio-dynamics offers the opportunity to enter a journey bridging spirit and science and a relevant, modern, necessary, fundamental to communities that are presented with situations such as land reform, redistribution, traditional wisdom, and the responsibility to develop skills, knowledge, competencies , technology to live in osmosis and symbiosis with the land.

Research Question
How to apply holistic notions of our human agrarian presence in the macrocosm-microcosm reality ?

Research Method
Discovery of the visible and invisible aspects and energies of the connection between the Universe and the Earth.

Results
How to handle ethically the complexity of our daily life on the land where we live. conclusion: the emerging of the Next Opensource World (NOW) and our collective and individual contribution to the evolution of consciousness.

References

Challenge of our times (Rudolf Steiner)
Hymn to the Universe (Pierre Theilard de Chardin)
Holism and evolution (Jan Christiaan Smuts)
la Commune (Joseph Proudhon)
Ubuntu - (Lovemore Mbigi)

Keywords

Coherence, resonance, convergence, abundance

Food for the future scenarios with regard to climate and environment based on ecological recycling agriculture farms in Sweden

Ph.D Artur Granstedt[1]

[1]Järna International Steiner College, www.sbfi.se Co Author Olof Thomsson, PhD Agronomy, Swedish Biodynamic Research Institute, Järna, artur.granstedt@jdb.se

The food's climate impact in Sweden is calculated at 18.8 million tonnes CO_2 eq. (approximately 2 tonnes CO_2 eq. per capita and year - about 20 % total per capita climate footprint) including imported food and production resources from other countries (Cederberg, 2019). This includes the use of chemicals in agriculture, imported feed and emissions from deforestation to produce more agricultural land for meat consumption. Processing and distribution account for about 20%, while the main burden (more than 1,5 tonnes per capita) comes from food production in agriculture

Biodynamic and other ecological (organic) recycling farms selected all over Sweden, covering the main types of soil and climatic conditions in the country, from south with an annual mean air temperature (1961-1990) of +7 °C (Skania) to +2 °C in the North. The selected 22 good-example farms fulfill the definition for ecological recycling agriculture defined in the EU part funded project BERAS (Granstedt et al, 2008; Larsson, Granstedt & Thomsson 2011; Granstedt & Seuri, 2013). They are ecological farms, more or less self-sustained, use diverse crop rotation and symbiotic nitrogen-fixing legumes in interaction with site appropriate human-food crops. In most cases they have animal production based on own fodder production for mainly coarse fodder fed ruminants.

The results show that the example farms' climate impact per hectare of agricultural area on average was 82 to 88% lower, considering the carbon sequestration in the soil in each cultivation system and the nitrogen surplus 43 to 49 % lower than today's average conventional agriculture in Sweden. Two scenarios, based on two different diets, showed that national self-sufficiency (estimated for 11 million inhabitants by 2030) based on the example farms, using mainly local and renewable resources, could be produced on a total of 2.7 – 3.1 million ha (available today 3 million ha but historically 3.5 million ha). It requires, however, a radical dietary change with a 44% reduction from today's average consumption of meat from ruminants (27, 1 kg per capita and year) and at least 90% less meat from monogastric animals (mainly chicken and pigs, 55.4 kg per capita and year) and 0- 30% less milk consumption from the current level (357 kg milk). These reduction in food from animals is in our scenarios compensated by a higher consumption (and thus production) of vegetables and root crops while the current level of cereal products is maintained.

The scenarios reduce the food's climate impact from agriculture to between 80 and 100 kg CO_2 eq. per capita, considering the carbon sequestration of organic grassland farming (Granstedt and Kjellenberg 2017) and traction based on renewable energy.

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Keywords
Biodynamic, Ecological Recycling Agriculture, global warming, carbon sequestration

Biodynamics in an agroforestry system: principles for the cultivation of medicinal herbs and strategies for health promotion.

MD Marcos Antonio Trajano Ferreira[1], *Ximena Soledad Moreno Sepúlveda, Nelson Filice de Barros*

[1]Associação Brasileira de Medicina Antroposófica Seção Centro Oeste, Seção Centro Oeste, chacarabindu@gmail.com

The high cost of the health field affects measures and reduces the adherence and effectiveness of actions in the care of people. There is never so much knowledge, resources and information available for care, however never have people felt so insecure and poorly cared for. For this reason, different integrative practices have been implemented to expand the capacity for care and autonomy of people with the available resources.

The objective of this work is to discuss the use of biodynamics in an agroforestry system for the cultivation of medicinal herb as a strategy for health promotion in the Brazilian Unified Health System. In 2018, in the face of an arbovirus epidemic, it was created for the biodynamic cultivation project of medicinal plants in a basic health unit, with the principles of agroforestry, participatory management founded on the Pedagogy of Doing and Anthroposophical. Regular task forces were carried out for soil preparation, cultivation, management and phenomenological observation of plant development, cosmic rhythms and the application of biodynamic preparations. All these actions were added to the principles of diversity, cooperation, strata and succession adopted by Ernest Götsch in the development of syntropy.

This set of actions resulted in the creation of a regular health education agenda with community participation for the development of an integral approach to health. In the agroforestry planting spaces, the permanent presence of users and health professionals enabled the development of healthy practices, welcoming and psychosocial care in a network for mental health patients,

combating zoonosis vectors, improving the ambience of the basic health unit and consequent prevention absenteeism of servers and greater therapeutic adherence of chronic patients. Through debates on the proper use of the land and the tragedy of common goods, cooperation strategies between managers, health professionals and users of the health system were promoted, as well as introductions such as notions of the culture of peace, autonomy, health surveillance , cultural competence, allocation of genetic resources and sustainable use of biodiversity for the health of communities.

Conclude if the experience of using biodynamics in agroforestry systems worked very well for the cultivation of medicinal plants and enabled the development of a set of health-promoting actions in a basic unit of the Brazilian Unified Health System.

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Keywords

Biodynamic agriculture, agroforestry, anthroposophical medicine, medicinal herb, public health

Workshops

How I found the farm organism by researching on the fatty acid contents of cow-milk.

Katja Mahal[1]

[1]Biol, katja.mahal@icloud.com

This contribution to the biodynamic conference is developing further on the results of my study on milkfat quality of five finish Dairy breeds with special view on omega-3 and CLA fatty acids.

In the workshop we look at the results of the study and discuss how an interpretation of the statistic results from the viewpoint of individual farms can help interested farms and consultants to make relevant breeding and feeding decisions.

The workshop is for farmers, consultants and scientists.

Keywords
Farm organism, milk fatty acids, milk breed, old breeds

Arboreal Apiculture - a Phase Shift

Michael Thiele[1]

[1]Apis Arborea, michael@apisarborea.com

The field of arboreal apiculture - or a better term may be arboreal apiology - completely embraces the life forces and life gestures of honeybees, and mimics their natural, indigenous nesting environments.

It opens the way into a holistic apian cosmology and re-conceptualizes stewardship and apian nest design. It is pregnant with new possibilities, and novel ways of seeing. It has radically transformed our views and understanding of the apian being and introduced a fundamental challenge to default beekeeping practices.

It also initiated a new era of apian conservation and preservation. Arboreal apiology has brought into our awareness notions of agency and sentience of honeybees and advocates for the rehabilitation of their basic birthrights.

In this workshop, we will look at the implications for biodynamic beekeeping and conservation in general in the time of the Anthropocene. Michael is the executive director of Apis Arborea, a US-based nonprofit, and will illustrate this pioneering new field by sharing current research and conservation and re-Wilding programs.

Keywords

Arboreal apiculture; rehabilitation of birth rights; ecology of selves; rewilding

Integrating Valerian into Tropical Agricultural Landscapes

Andrea D'Angelo Lazzarin[1]

[1]ABD - Biodynamic Association in Brazil, adangelolazzarin@gmail.com

The workshop intends to show and exchange experiences with the participants on the growing of Valerian in the tropical and subtropical regions using a study case from Brazil. The importance of the personal relationship, dedication and comprehension to the plant and the environment. As well the observation on the native similar plants. Building such a condition for valerian development in several surroundings evidenced the progress of a more resilient landscape.

Keywords

biodynamic preparation, tropics, cultivations core, farmer, valerian

Twenty years' research experience on biodynamic farming research on horticultural crops

Ram Awadh Ram[1], *Atul Singha, S Rajan and Shashi Sharma*

[1]ICAR- Central Institute for Subtropical Horticulture, Crop Production, Rehmankhera, P.O. Kakori, Lucknow-226 101, India. Contact: raram_cish@yahoo.co.in

Biodynamic package of practice was applied in field for growing of subtropical fruits (mango, guava and aonla (Indian Gooseberry) and vegetables (tomato, cauliflower, cabbage etc.) in randomized block design with 3 replications. Insect pest management in all experimental trees was done with spraying of biodynamic liquid pesticides and lime sulphur.

Initial soil sample was drawn before the application of biodynamic package of practice and initial soil properties revealed that the organic carbon, available P and K and population of mould and bacteria were 0.53 %, 8.66 and 140 ppm and $1.3x10^4$ and $3.7x10^6$ cfu/g, respectively. After three years of interventions significant improvement in physical, chemical and biological properties of the soil was noticed as organic carbon, available P and K and population of mould and bacteria were improved to 1.16 %, 56.27and 1062.25 ppm and $8.5x10^4$ and $3.1x10^8$cfu/g, respectively.

Four types of composts, i.e., Biodynamic, NADEP, Vermi and Micro Mediated (MM) were prepared with locally available materials with minimum use of cow dung. Nutrients level of these composts along with Cow Pat Pit (CPP) was almost 2-3 times more than normal compost. Biodynamic compost contained N (1.68%), P (0.17%), K (1.23%), Zn (96 ppm), Cu (45 ppm), Mn (357 ppm) and Fe (3352 ppm) compared to 0.70%,

0.10%, 0.37%, 75 ppm, 34 ppm, 222 ppm and 3134 ppm, respectively in farm yard manure.

Initial nutrients level of common farm yard manure N (0.70%), P (0.19%), K (1.37%), Zn (75 ppm), Cu (34 ppm) were improved after fortification with cow pat pit to N (1.02%), P (0.38%), K (0.32%), Zn (80 ppm), Cu (45 ppm) which indicates that application of compost quantity can be reduced per unit area to minimize the cost of production.

Microbial population improved in soil after the application of different organic treatments viz., total bacterial count was recorded maximum ($8.1x10^6$ cfu/g soil) with application of BD-500 + FYM 10 kg/tree.
Application of biodynamic compost (30 kg $tree^{-1}$) + bio-enhancers cow pat pit (CPP) 100 g, BD- 500 and BD- 501 as soil and foliar spray) was applied 35 years mango trees. After two years of experimentation, maximum increase in total bacterial population ($69.14x10^8$), actinomycetes (38.94×10^6), microbial biomass (750.27 mg/kg), microbial biomass phosphorus (4.58 mg/kg), microbial biomass nitrogen (181.42 mg/kg), alkaline phosphate activity (136.37 µ g pnp/g/h) and acid phosphate activity (80.26 µ g pnp/g/h) was recorded.

In another experiment, application of BD-500, vermiwash, vermi compost and CPP in papaya improved soil bacterial and mould population (5.3×10^6 & 3.3×10^4 cfu/g soil).
Application of biodynamic package of practice in guava, improved the fruits/yield (319/33.20kg/tree) and fruit quality TSS, ascorbic acid (12.66^{0}Brix and 231.38mg 100/fruit) and reducing sugars in fruit (4.70%).

In organic production of mango, maximum fruit number (403.83/tree) and fruit yield (108.98 kg/tree) was recorded with biodynamic package of practice. It improved the fruit weight (0.261kg). Application of biodynamic package of practice in Indian goose berry improved the fruit yield and quality parameters of Indian gooseberry.
Cauliflower and cabbage were successfully grown with application of composts, BD preparations and BD liquid manure and yield was recorded up to 42.58 t/ha in cauliflower and 56.16 t/ha in cabbage.
Application of biodynamic package of practice was done in cauliflower, cabbage, Okra and cowpea production following the randomized block design. Observations revealed that maximum yield (95.95 q/ha. (Cauliflower), 178.73 q/ha (cabbage) and 89.27 q/ha. (ladies finger/okra) was recorded highest.

Sowing of seeds of Okra was done as per biodynamic calendar and without following the calendar in randomized block design. Result showed that highest yield (125.00 q/ha) was recorded when seeds were sown on Moon opposite to Saturn and on fruit day.
Neem and *Pongamia* based biodynamic liquid pesticides (50%), used against first instar nymphs of mealy bug and it caused the mortality ranged from 76.67 to 100 % on 7th day.

In an experiment, mango hopper management was done with spraying of neem based biodynamic liquid pesticide. Spray was carried out twice (11th and 14th SMW) after panicle emergence stage. The observation on mango hopper population was recorded during the flowering and fruiting period at weekly intervals. Before spray, the hopper population was 3.07/panicle and after the spray the reduction in the insect population was found up to 15th SMW with 0.95. Second spray was taken up at 14th SMW, as result insect population reduced to 0.4 hoppers /panicle up to 19th SMW. Powdery mildew was managed with spraying of BD - 501 and 0.2 % lime sulphur.
A typical phenomenon in mango, i.e., setting of fruits at the tip of the floral panicles in 'cluster' has been observed since a number of years in mango. The phenomenon is locally called as jhumka (clustering). Setting of fruit in cluster occurs in a number of mango varieties with varying degree of intensity and in Dashehari variety of mango about 80 % of the trees were found affected. An estimated loss of crop due to clustering disorder during the year 1993 was in the range of 60.00 to 80.00 %. Its occurrence was not noticed at biodynamic research farm, which was

managed with biodynamic package of practice for 4 years.

On farm production of biodynamic inputs production and use were also demonstrated to the farmers. Biodynamic inputs are rich source of microbial consortia, macro, micronutrients and plant growth promoting substances. These were used for seed/ seedlings treatments and spraying crops and soil. On farm production of bio-pesticides with herbal, medicinal plants and animal products were also demonstrated to the farmers for management of insect pests.

Several off farm and on farm training programmes and field demonstrations were organized for on farm production of quality organic inputs and their use in various crop productions continuously for 11 years. 212 farmers were trained and 125 demonstrations were organized in 450 ha of land in Sikkim, Assam, Nagaland, Arunachal Pradesh, Manipur, Tripura and Mizoram of India. This impacted that Sikkim has become first organic state of India. In Bundelkhand region of Uttar Pradesh, India 125 farmers were also trained and 125 field demonstrations were organized for popularization of the practice.

Thirty seven farmers of Azamgarh district of U.P., India adopted biodynamic farming for production of medicinal crops and earned profit from INR 3, 45, 00.00 to INR 4, 36,000.00/ha and in Lucknow districts of U.P., India 31 farmers adopted package for vegetables crops and earned net profit from INR 20, 000.00 to INR 36, 000.00/ha over conventional cultivation.

Yield of mango cv. Mallika was taken for economic analysis showed that the minimum cost of production (INR 5.41/kg), maximum production (10898.67kg/ha), total production value was recorded maximum (INR 163480/ ha) and maximum benefit cost ratio (5.10) was obtained with application of biodynamic package of practice.

Comparative assessment of pollinators was made on their populations in mango in different environments viz., organic farm of the institute and conventional farmers' orchards. Assessment of insect pollinator populations at different locations and environments revealed that the pollinator populations were adequate at organic farm of the institute. At farmer's fields where orchardists regularly used synthetic pyrethroids in addition to other chemical pesticides, insect pollinator's numbers were very low. In such orchards average pollinator population was very low 0.50-0.80 and the fruit set 0.60-1.60 per panicle.

Conclusion

Biodynamic preparations are cheap source of agriculturally important microbes having miscellaneous PGPR and biochemical activities. The present study reveals that biodynamic preparation viz., cow pat pit, BD-500, BD-501, BD (502-507) and biodynamic liquid pesticide are potent source of nutrients, microbes have PGPR potential antagonistic properties against *C. gloeosporioides, C. fimbriota, P.* aphanidermatum and *F. oxysporum*. Therefore, these formulations can be effectively used for nutrient and pest management in organic production system.

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Keywords

Cow Pat Pit, BD-500, Actinomycetes, Azotobacter, Azospirillum and Plant Growth Promoting Activities

Individuality, Intuition and Health in Agriculture: A Landscape Perspective

M.Sc. Ricardo Colmenares[1], *Sebastian Iniesta[2], Albacete Eduardo Sanchez[3], Catalonian Javier Parra[4], Ramón Alarcon[5], Concepción Fabeiro[6], Klaus Merckens[7]*

[1]Con Respeto Association, rcolmenares@telefonica.net

[2]Biodynamic Farmer, Las Encebras Farm

[3]Recognized Advisor Demeter

[4]CEO Irjimpa Limited Company Demeter certified (Cuenca)

[5]CEO Albaga Limited Company Demeter certified (Albacete)

[6]Agronomist UCLM (University Castilla La Mancha) (Albacete)

[7]Recognized Advisor Demeter. CEO Merckens Development Support, Ulm, Germany

The concept of a farm as an individuality, proposed by Steiner in the Agriculture Course, is one of his most powerful contributions to agriculture today. The human being plays a key role in integrating all the natural kingdoms in the farm, thus shaping and determining its identity, biography and health.

The farmer's intuition, self-observation and self-reflection abilities are now increasingly recognized as indispensable tools to keep a farm in good health (1). "An organism can only be apprehended through an intuitive approach" says Steiner (2). Working with farmers on observing the farm landscape and its environment contributes to the development of their intuitive skills. It opens up a new perspective on the farm they're responsible for, and on the landscape of which their farm becomes an integral part as an organ of it.

This regard, the work of Jochen Bockemühl (3) and those inspired by him (4 & 5) has made available to farmers a working methodology on the subject with a landscape approach, to work out on a farm level and beyond it.

In this sense, the Spanish Agro Cultura Con Respeto Association is carrying out this exercise in the advisory and training work of an organic pistachios' cooperative in Ciudad Real, Spain. After the exercise, farmers realise that their connection to the landscape is fairly close. However, they only see the things that are most closely related to their agricultural activity, f.e. the white storks walking behind the tractor while ploughing; the bee-eaters, spring migrants, as a threat to beekeepers; the appearance of ladybirds when aphids emerge, or emblematic species such as the great bustard or the common trumpeter crane, an autumn migrant.

This shows they don't have yet a view of their landscape as a whole and many details of relevant connections between farm management and the environment are lacking. Through the methodological work quoted above, it's possible to enhance the farmer's intuitive abilities, which are key to healthy landscape and farm management. However, it requires lifelong training, so more attention should be paid in the training programs for biodynamic farmers. Furthermore, in a community work with

several farmers in an area, that feel committed to offering to consumers a product of highest quality, the practiced exercises become richer and strengthen the internal bonding for that common endeavour. Therefore, we strongly recommend the use of this methodology elsewhere.

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Keywords

Individuality, intuition, health, biodynamic training, Central Spain

Focus on Farmers: Certification as a Tool for Farm Development

M.Sc. Schirin Rachel Oeding[1]

[1]University of Hohenheim, Demeter e.V., schirin.oeding@demeter.de

Demeter e.V.'s alternative certification project has allowed us to introduce something big, even radical, to our members and partners, and pilot a new approach to biodynamic certification by adding a new dimension to the participatory certification approach. We are creating something our members have been requesting for years: an approach that puts the focus on farms and farmers, not checklists and inspections.

Thus, we open ourselves up to a development that has the potential to bring vitality to the way we recognize our farmers' accomplishments; foster the creation of high quality products, and build vibrant knowledge-sharing networks.

During the project, our participating farms receive their Demeter certification following a rigorous, moderated farm development talk. Each year, for five years, we add farms to the participant group until up to 100 farms are partaking in 2022. In 2020 we added an initiative for small-scale processors which will run along the same lines as the alternative certification scheme for farmers, but adapted to the special challenges faced by Demeter-certified processors.

We are working together with the University of Hohenheim im Stuttgart, Germany to develop our methods, accompany us in the process and scientifically evaluate the results to help us decide how this model can best be implemented on a broader scale. Our focus is on giving farmers and processors the tools they need to build stable networks of peers and stakeholders, such as customers, and maintain or improve the quality of their products and the standard of their work.

The future of our farms is reliant on the people who operate those farms: without a strong social foundation, sustainable agriculture is just a buzzword. This project

gives us the opportunity to test a radical hypothesis: when farmers feel supported in their work and have access to information and networks and regularly receive structured input, they will be less likely to breech the certification standard. In fact, the overall quality of their work will improve and the attractiveness of their farms for future generations will increase.

As our project is currently under way, we will not be able to present final results at this year's conference. Nevertheless, we feel that our preliminary results and insights may be of interest. We would be happy to share these with the conference attendees as a workshop, giving insight into the project and our approach to farm development talks.

Keywords

Alternative certification, trust, peer-to-peer, knowledge sharing, life-long learning, farm talks

Plant growth promoting, biochemical and antimicrobial properties of microbes isolated from various Biodynamic preparations

Ram Awadh Ram[1], *Atul Singha Scientist, Govind Kumar, Shailendra Maurya, S Rajan*

[1]ICAR- Central Institute for Subtropical Horticulture, Crop Production, Rehmankhera, P.O. Kakori, Lucknow-226 101, India, Contact: raram_cish@yahoo.co.in

Biodynamic farming refers to "working with the energies which create and maintain life. It's a process of healing earth with vital forces through human efforts. Using biodynamic preparations regularly opens the soil to cosmic activities and allows these to work through soil into the plants. The aim of biodynamic concept is to establish a system that brings balance into all factors, which maintain life. In biodynamic farming energy harnessed from cosmos, plant earth and cow. Biodynamic compost, BD-500, 501, cow pat pit, biodynamic preparations (502-507) and biodynamic liquid manure/pesticides are produced at the farm for nutrient and insect pest management. To find out scientific explanations to prove the efficacy of biodynamic inputs extensive research was done and connected to modern science.

1.Cow pat pit

Cow pat pit contained maximum number of microbial colony ($96x10^6$ CFU/ml) observed on the Actinomycetes agar and Kings B agar medium (specific for actinomycetes and pseudomonas, respectively) as compare to bacterial colony observed in nutrient agar medium ($80x10^6$ CFU/ml), Pikovskayas agar ($76x10^6$ CFU/ml) and other media. It is also recorded that significant number of microorganisms appeared in CRYEMA ($32x10^6$ CFU/ml), N-free malate medium ($64x10^6$ CFU/ml) and azotobacter specific Jenson's agar medium ($56x10^6$ CFU/ml).Total number of fungi ($20 x10^6$ CFU/ml) observed on Rose Bengal agar medium.

Fifty five microbial isolates (52 bacteria, 3 actinomycetes) were isolated and evaluated for different plant growth promoting attributes viz. ammonia, indole acetic acid, siderophore and HCN production. Among them 9 bacterial isolates and 3 actinomycetes isolates were from CPP and rest 43 bacterial isolates were from other biodynamic preparations. Actinomycetes isolated from CPP showed siderophore and HCN producing activity (CISH-PGPA 13). Similarly, CISH-PGPA 15, an actinomycetes isolated from CPP also produced both

ammonia and IAA in the test medium conducted in the laboratory.

Cow pat pit enriched in mineral salt medium (MSM) with chlorpyrifos (1%) as sole carbon source for isolation of potential microorganisms and their application for chlorpyrifos (@2.5%) biodegradation. The strains *Pseudomonas aeruginosa*-CPP14 (MT043911), *was* identified from Cow Pat Pit. This strain was tested positive for plant growth promotory properties like P, Zn, K solubilization, IAA & siderophore production and also inhibit the growth of potential plant pathogens (biocontrol activity) like *Ceratocystis fimbriota* (MTCC-2281), *Pythium aphanidermatum* (MTCC-284), *Colletotrichum gloeosporioides* (MTCC-2190) &*Fusarium oxysporum* (MTCC-10247). Based on enrichment, PGPR and biocontrol activity consortium (C1 and CPP14) was developed and tested for chlorpyrifos biodegradation (@2.5%) in pot trial (SS-sterile and NSS-nonsterile soil) in comparison with single strain. Consortium C1 degrades 94.96% of chlorpyrifos in non-sterile soil as compared to control (23.55%) after 9 days of interval. The identified strains of this study have huge potential to degrade chlorpyrifos that can further use for soil reclamation from pesticide contamination and plant growth promotion.

Based on biochemical tests, most potent isolates were selected for antimicrobial properties against some selected pathogens. Microbial isolate from cow pat pit i.e. CPP-14 inhibited the growth of *F. oxysporum* and *P. aphanidermatum* by 60.34 and 17.67 % but failed to affect the growth of *C. fimbriota* and *C. gloeosporioides*. CPP-2 inhibited the growth of all fungus i.e. *C. fimbriota*, *C. gloeosporioides, F. oxysporum* and *P. aphanidermatum* by 49.83, 51.49, 28.98 and 14.39%, respectively. CPP-7 and CPP-8 has also inhibited the growth of all four pathogens.

2.BD-500
he microscopic characterization and PGP properties of microbes were observed. Test strains BD-1, BD-3, BD-5, BD-7, BD-9, BD-11, BD-13, BD-15, BD-17 and BD-19 were tested positive for Zn solubilization, P solubilization and siderophore production. This indicates that application of BD-500 in soil improves soil fertility through Zn solubilization, P solubilization and siderophore production microbes.

3.Cow horn silica (BD-501)
The maximum number bacterial colony ($30x10^5$ CFU/ ml) was observed in the Pikovskaya's agar medium (specific for *Azotobacter*) as compare to *Azospirillum* ($30x10^6$ CFU/ ml), G^+ bacteria ($20x10^5$ CFU/ ml), Actinomycetes ($8.0\ x10^5$ CFU/ ml), Rhizobium ($13.0x10^5$ CFU/ ml), G^- bacteria ($18x10^5$ CFU/ ml), Pseudomonas ($6x10^5$ CFU/ ml), P-solubilizing bacteria ($30x10^5$ CFU/ ml) and other bacteria. Total number of fungi ($1x10^5$ CFU/ ml) observed on Rose Bengal agar medium.

Based on morphological (microscopy) characterization, total 15 efficient bacteria (501-1 to 501-14) were screened and observed. All the isolated bacteria were tested PGP properties viz; P-solubilization, siderophore production, IAA, amylase, K and Zn solubilization and HCN production. 501-1 and 501-2 tested positive for P-solubilization and Zn solubilization. Test strains 501-7, 501-11 and 501-14 were tested positive for Zn solubilization. Test strains 501-7, 501-11 and 501-15 were also tested positive for IAA production. None of test strain was tested positive for amylase, potassium and HCN production.

4.Biodynamic preparations (502-507)
Microbial characterization, biochemical and plant growth promoting activities of microbes isolated from these preparations.
BD- 502
Biochemical characterization of isolated cultures BD-502-16 showed positive activities for urease and H_2S production while BD-502-10 showed positive for malonate utilization lysine utilization, urease, H_2S production, citrate utilization, malonate utilization, esculin hydrolysis, saccharose, ONPG and catalase.

5.BD- 504
Biochemical characterization of isolated cultures BD-504-1, 4, 6, 7, 16, 18, 19, 20, 27 showed positive activity for urease and H_2S production while BD-502-10 showed positive for Malonate utilization Lysine utilization, urease, H_2S production, citrate utilization, Malonate utilization, Esculin hydrolysis, Saccharose, ONPG and Catalase.

6.BD- 505
Biochemical characterization of isolated cultures BD-505-4,12,20,21, 22, 22, 23 and 24 showed positive activity for urease and H_2S production while BD-502-10 showed positive for Malonate utilization Lysine utilization, Urease, H_2S production, Citrate utilization, Malonate utilization, Esculin hydrolysis, Saccharose, ONPG and Catalase.
Seven potential microbes isolated from BD-505 and tested for various plant growth promoting activity. BD-24 and BD-4 were tested for Zn solubilization, BD-4, BD-20, BD21, Bd-22, BD-23 and BD-24 were tested positive for phosphate solubilization, BD-24 and BD-21 were found positive for HCN production and BD-12 and BD-24 were tested positive for siderophore production.

7.BD- 506
Biochemical characterization of isolated cultures BD-506-2,4,5,7,8,13,14,16,17,20,25 and 28 all potential microbes were tested for various plant growth promoting activities. BD-4,7,8, 11 and 22 were tested positive for siderophore production, BD-506- 5, 14, 15 and 16 were tested positive for Zn solubilization, BD-506- 25 was tested highly positive for Zn, P solubilization and siderophore production. None of microbe tested positive for HCN production.

8.BD- 507
After biochemical characterization of isolated cultures BD-507-10, 11, 17 and 26 all microbes were tested for various plant growth promoting activities. BD-507-17, 26 and 6 were tested positive for P solubilization and all the isolates were tested positive for siderophore production and all the isolates were tested positive for IAA, siderophore production and Zn solubilization. None of microbe tested positive for HCN production.

9.Biodynamic liquid pesticide
Biodynamic liquid pesticide (BL) was prepared with materials i.e. cow dung, urine and leaves of neem, caster leaves and other medicinal plant parts. Besides cow dung, cow urine and one set of BD-preparations (502-507) were incorporated. After 14 days microbial analysis of preparation was done. Maximum number bacterial colony ($225x10^6$ CFU ml^{-1}) observed on the Methyl Red agar medium (specific for gram positive bacteria) as compare to Azospirillum ($200x10^6$ CFU ml^{-1}), G^- bacteria ($5x10^6$ CFU ml^{-1}), Actinomycetes ($110x10^5$ CFU ml^{-1}), P solubilzing bacteria ($160x10^6$ CFU ml^{-1}), and other significant bacteria. No fungus colony was detected in the preparation.

Biochemical characterization of isolated strains i.e. Bl-8 and BL-2 showed positive activity for lysine utilization, ornithine utilization, urease, nitrate reduction, H_2S production, citrate utilization, voges Proskauer's, malonate utilization, esculin hydrolysis, saccharose, raffinose, trehalose, nitrate reduction, glucose, lactose, Catalase. IMViC test also performed for identification of proteobacteria group of species. Test isolates Bl-5 and BL-2 showed positive test for citrate utilization while BL-11 showed positive test for ONPG and Adonitol. For sugar utilization test isolates BL-8 and BL-2 showed positive results for Saccharose utilization.

Based on morphological and biochemical characterization total 5 efficient bacteria (BL2, BL 5, BL 8, BL 11) were screened from biodynamic liquid pesticide formulation and observed that all bacteria were gram positive. All isolated bacteria were tested for PGP properties, and BL 8 showed maximum PGPR properties including Phosphorus, Zinc solubilization, siderophore production as compare to other test isolates.

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Keywords

BD-500, HCN production, anti microbial property, F. oxysporum, citrate utilization

Tropical Regenerative Agriculture (ART) methodology and weed inhibition

M.Sc. Cristiane Guerreiro[1], *Carlos Armênio Khatounian[2], Manfred von Osterroch[3]*

[1]NGO RDA - Retorn of trees, projetos@regenerativa.art.br

[2]University of São Paulo, ESALQ, Phytotechnics Department, ESALQ, Picacicaba/SP, Brazil)

[3]ART Project - NGO RDA - Itápolis/SP, Brazil

ART is an evolving methodology born from anthroposophy adapted to the tropical climate and to the current situation of climate change. It is based on the development of trees in the vegetable garden which are suppliers of RCW (ramial chipped wood).
It also uses dense green manure as a source of soil fertility. Both practices seem to be good allies not only in soil fertility but also in weed inhibition, especially grasses.

We invite you to talk about the principles of ART and the results we achieved during the first cycle of investigation.

Keywords

ART (Tropical Regenerative Agriculture), weeds inhibition, CRW

Influence, Inspiration and Improvisation as Tools in a Garden Maintenance Plan

Paula Pihlgren[1]

[1]Skillebyholm, Komvux, paula@skillebyholm.com

My focus is on understanding place as a source of inspiration; that is, a place's identity, genius loci, or the essence of the place. By working for a long time with a place and studying it, a gardener acquires a unique knowledge of its essence. This site knowledge is part of a kind of knowledge that is experience-based, also called the practical or tacid knowledge. A gardener acquire practical knowledge during a long period of work in combination with basic theoretical and technical knowledge. Site knowledge plays a major role in, for example, design, function and choice of activities. However, experience-based knowledge is difficult to convey and create a common understanding around.
For professional gardeners a dilemma often arises towards both employees and clients when this knowledge is communicated. One way to communicate park management is to compile a garden maintenance plan. But an ordinary maintenance plan does not take into account the practical knowledge but is formulated so that basically anyone can do the tasks. Consequently aspects of in-depth understanding may eventually disappear, which undermines the possibility for the essence of a place to come to its proper expression.
This in turn means that in-depth interactions between nature and people are overshadowed and that ambitions for holistic thinking remain theories. A maintenance plan for green spaces need to be supplemented with a dynamic working method that can be described and valuated.

I therefore want to investigate whether it is possible to find a method for this that includes the practical knowledge. A dynamic method involves elements of uncertainty, reflection, and constant re-evaluation as these create experience-based knowledge. In this workshop, I will lead a discussion about tools for an in-depth study of experience-based knowledge in a garden context.

In the workshop, the conversation will be about: - What influences a gardener? - What inspires a gardener? - What does improvisation mean for a gardener? - Can these three concepts (Influence, inspiration, improvisation: see Marcia sá Cavalcante Schuback) function as tools for a development and deepening of a maintenance plan? - How to raise awareness of practical knowledge and how can it be given weight in an organization?

About: The workshop leader has many years experience developing the biodynamic park and garden that was founded by Arne Klingborg in Järna. She now works as a teatcher and gardener at Skillebyholm Gardening Educations in Järna. She uses her practical knowledge as a basis for phenomenological studies of tacit knowledge.

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Keywords

Garden maintenance plan, genius loci, essence of the place, experience-based knowledge, practical knowledge

Poster Contributions

Beyond standard Valerian use

Melinda Bateman[1]

[1]Farmer. Contact: mstarfarm@gmail.com

I wanted to see if I could grow salad greens in my un-heated Greenhouse using the Valerian seed treatment that Enzo Nastati gave in his first USA seminar in Paonia Colorado in September of 2013. The purpose or result of this treatment was to have plants that would withstand extreme cold, continue to live and bear produce. Prior to 2013 I could not grow any cash crops in this Greenhouse from November through February.

Methods; using Biodynamic Valerian potentized to 100x , details of this method are explained at the end of this paper. I spritzed a tbsp. of this preparation onto a cup of lettuce seeds. I closed these seeds up in a plastic tupperware box for 24 hours. I also treated Arugula and Spinach seeds in the same way. Seeds were treated on October 10, 2013.

On October 17th 2013 I planted the treated seeds. 1 bed of spinach, 1 bed of Arugula and 2 beds of Lettuce. Each bed is approx. 3 feet x 80 feet.

I sprayed many additional treatments of Valerian into the air in the Greenhouse above the plants, dates and temperatures as follows;
November 25th Greenhouse 7 degrees
November 26th Greenhouse 10 degrees
November 27th Greenhouse 7 degrees
November 28th Greenhouse 10 degrees
December 6th no temperature recorded
December 8th – 15 degrees outside, 21 degrees under row cover on Arugula bed

All results or yields of any and all crops are an increase in previous production because I could not prior to using this Valerian treatment grow crops in my unheated greenhouse in Taos New Mexico at 7800 ft from November through March. Prior to 2013 and the use and experimentation with this method I could only seed crops starting in late February and ending in October or early November

Keywords

Valerian, sub-zero temperatures, production,

A handbook on the Bio-Dynamic Preparations

Walter Stappung[1]

[1]WStappung@yahoo.com

Question
97 years after Rudolf Steiner's Agriculture Course we still are missing a comprehensive basic formation for instructors and researchers for the Bio-Dynamic Preparations. Rudolf Steiner's instructions

are often overseen and forgotten. Many valuable experiences which are reported in the Bio-Dynamic literature are not easy to find.

Methods

- Trying to learn do all the works around the Preparations by myself.
- Inquiring into every question which appeared.
- Studying Rudolf Steiner's Agriculture Course and other works of Steiner.
- Collecting everthing about the making and application of these Preparations.
- Consulting many libraries and archives.
- Consulting also litterature about important themes as the anatomy of the organs we need for the making of these Preparations.
- Corresponding and working with pioneers: Hugh Courtney, Hugh Lovel, Peter Proctor, Alex Podolinsky, Pierre and Vincent Masson etc.
- Checking methods for their feasibility and developping new methods.

N.B.: The effectiveness oft he methods is not part of this research although it puts many questions.

Result

A book with 748 pages full of practical information and accurate descriptions, with a bibliography with much more than 4'000 citations.
A manual and encyclopedia for practice and research.

Conclusion

Although this book is not perfect, we have a basis now. This overview raises many questions. Some may give rise to further research. Others should not be answered in general. In practice, we need many possibilities because we have not everywhere the same prerequisites.

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Keywords

The Handbook for the Bio-Dynamic Preparations

Influence of homeopathic preparations substances and phase of the moon on the growth pattern of rice seedlings

***Rovier Verdi*[1],** *Leonardo Felipe Faedo*[1], *Francis Rayns*[2], *Julia Wright*[2], *Pedro Boff*[3]

[1]Santa Catarina State University and Coventry University, Centre for Agroveterinary Sciences and Centre for Agroecology, Water and Resilience, verdir@uni.coventry.ac.uk

[2]Coventry University - Center for Agroecology, Water and Resilience, UK.

[3]Laboratory of Plant Health and Homeopathy - Lages Experimental Station of EPAGRI, BR.

Kolisko and Kolisko were the pioneers in testing the biological effects of highly diluted (smallest entities) and agitated (a kind of potentization) substances in plants. Since 1923 they carried out a series of experiments, mainly with wheat seedling germination and growth assay, to determine the potency curve – a graphical representation of the effects measured as a

function of potency levels – specific for each substance.

The aim of the research described in this paper was to determine the potency curve of homeopathic preparations of Silicea terra (Sil.) and Calcarea carbonica (Calc.) on rice seedlings and assess its interaction with the moon phase. The trials were carried out at the Centre for Agroecology, Water and Resilience, Coventry University, United Kingdom, between April and September 2020.

The experiment was composed by 8 repetitions, 4 beginning on the new moon and 4 on the full moon. They were conducted in a growth chamber with a controlled environment for 13 days. The treatments were randomized and a double blind approach to the preparation identity was used. Sil. and Calc. were applied, each from 5 to 30CH (CH= hahnemannian centesimal dilution order) using deionised water and dynamized deionised water as the controls.

Each treatment comprised 15 seeds in a pot and the controls comprised 45 seeds in 3 pots. The length of the first and second leaf were measured.

The results showed that each homeopathic preparation presented a distinct potency curve and they were influenced by the moon phase. For the first leaf growth in the full moon, Sil. presented the maxima at the 18, 19, and 21CH and the minimum at 9, 10 and 26CH while the maxima for Calc. were at 5, 6, 12CH and the minimum was at 7, 18, and 26CH. However, at the new moon, the maxima for Sil. were at 16, 17, and 27CH and the minimum were at 12, 20, and 25CH while for Calc. the maximum were at 9, 16, and 18CH and the minimum were at 15, 19, and 26CH. For the second leaf growth at the full moon with Sil. the maxima were at 7, 23, and 24CH and the minimum at 12, 25, and 28CH while with Calc. the maxima were at 5, 10, and 29CH and the minimum at 17, 20 and 28CH. However, at the new moon Sil. maximum were at 5, 7, and 28CH and minimum at 6, 12, and 25CH while Calc. has the maximum at 24, 26, and 28CH and the minimum at 12, 13, and 17CH.

This experiment shows that with increasing potencies (CH) the influence on plant grow may something be favourably or unfavourably. The kind of influence depends on the homeopathic preparation and its potency used as well as the moon phase when the treatment is applied.

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Keywords

Silicea terra, calcarea carbonica, potency curve

Goethean morphological test

Ph.D. Barry Lia[1]

[1]Lia BD Consulting, barrylia@comcast.net

Based upon Jochen Bockemühl's leaf "morphic movements," mature leaves of arugula (a "leaf" plant) were studied after sowing, according to Maria Thun's sowing calendar, when the moon was in a fruit sign, root sign, leaf sign or flower sign.

Eight replicates were laid out in a four by eight garden plot in a random block design. Stem length, leaf blade length, leaf width, and the number of points (or lobes) were measured.

There were no appreciable differences in measurements among plants sown during the four zodiacal signs, except that the plants sown during the ROOT sign showed more sectioning (points/lobes). Something apparently may be going on with the position of the moon. However, this does not readily fit with Thun's four-fold plant/zodiacal scheme for a "leaf" plant.

Replication and more detailed analyses of concurrent lunar rhythms are in order.

Keywords

Goethean, Bockemühl, Thun calendar, morphology, lunar-zodiacal

Biodynamic pepper as a promising method in the control of Atta sexdens

Maria Eugênia Gobbo Mercadante[1]

[1]Brazilian Association of Biodynamic Agriculture, mariagobbo93@gmail.com

Biodynamic Agriculture was renowned by Rudolf Steiner in 1924, and consists of being a model of sustainable agriculture that acts mainly in the relationship between plant growth and cosmic rhythms together with the maintenance of soil fertility. Another important premise is the least possible dependence on external inputs, prioritizing the self-regulation of the system. The Earth must be nourished so that cosmic influences can flow freely, and for this to occur, beneficial forces must work through animals and plants.

For Steiner (1924), insects that are considered "pests" within agriculture can be controlled by burning them, transforming them into ashes or into a kind of "pepper". Thus, it is possible that animal pests are distant from agricultural production fields, since the impact of the "pepper" fire will destroy the fertility of the target insect, in this case, of leaf-cutting ants.

Knowing that the region of Botucatu –SP has an abundance of Atta nests, the objective of this study was to test the efficiency of biodynamic ash / pepper as a possible control method in Atta sexdens, evaluating its activity of foraging before and after the application of the ashes for three consecutive months in the constellation of Taurus.

The methodology used in the present study was adapted from Rudolf Steiner (1924), Giesel (2007) and Forti et al., (2017). Firstly, it is extremely important to know which Atta scouts belong to the same nest, for this, the straw methodology was used (Forti et al., 2017), which consisted of cutting small pieces of plastic straws (0, 5 cm), soak them in orange juice and cover them with soybean meal, allowing them to rest for 24 hours at room temperature. After that, the four most active scouts and closest to the heap of land were selected, they were marked with a stake by color and number and the straws of a single color were placed in the respective demarcated scouts. As ants do not digest plastic, within a few days, straws were discarded outside the murundu or scouts, demonstrating which scouts correspond to the same nest, according to the colors.

With the confirmation of the trails, the second part of the experiment followed: the dynamisations and applications. The ashes / peppers used in this study came from the flock of Queens of 2019, which were stored in glasses containing hydro alcoholic solution for their conservation. Following the precepts of Biodynamic Agriculture, the application of dynamized ashes must be carried out when the Moon and the Sun are in the constellation of Taurus. However, as the experiment was carried out in the months of July, August and September 2020, only the Moon was in the constellation of Taurus. During the three consecutive months, it was established to dynamize 400 mL of D7 in 4 L of water in the costal spray, daily for the days of Taurus. To facilitate the process, in July, 10 L of D7 was stored in one gallon, which was used in the three months of application. The validity of the dynamizations is up to 2 (two) years.

The evaluations were made before each application, in order to count the number of ants in movement with and without load during one minute in their respective selected scouts, according to the methodology of Giesel(2007).

After counting, the application was made both in the selected scouts and in the nest, using a 5 L backpack sprayer. Temperatures and RH were measured before each application using a hygrometer.

In this experiment there was no complex experimental design, only the selection of a single nest and its four most active trails / scouts. Through observations and counting of ants in the three consecutive months of the experiment, it can be said that the results obtained were apparently promising, since the foraging activity of the saúvas decreased at the end of the tests, which makes biodynamic ash / pepper viable as a possible alternative method in the control of saúvas. It is suggested to deepen this study extending it for a period of 1 (one) year, so that other parameters such as seasons, constellations, phases of the Moon, knots, conjunctions, oppositions, eclipses, trines, perigee and apogee are evaluated and correlated, in order to identify whether there is any direct or indirect influence of these factors on the activity of ants.
In addition, it is extremely important that research in this area be promoted, enriching the scientific database in order to contribute to the accessibility of knowledge to all. It is concluded that the dynamized ash / pepper may be an economically viable and sustainable option in the control of healthy ants in Brazil.

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Miklós, 2008

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Kumar et al., 2019.

Keywords

Ashes; atta sexdens; biodynamic agriculture; pepper;

Pilot project to assess perennial vegetables for commercial production in Sweden

M.Sc. Eva Johansson[1]

[1]Skillebyholm research, eva.johansson@skillebyholm.com

Which perennial vegetables are best integrated into small-scale mixed vegetable market gardens?
Interest in growing and eating perennial vegetables has increased markedly in recent years. Perennial vegetables are an essential part of regenerative cultivation systems which are characterized by diversity with minimized tillage and inputs. Perennial vegetables often have deep roots which allows them to seek nourishment deeper, and need less irrigation and fertilization, compared to annual crops. They contribute to biodiversity and carbon sequestration. Many are nutritious.

Despite many advantages of perennial vegetables, research is lacking in areas that are crucial from a commercial production perspective.
Four organic and biodynamic market growers in Sweden participate in the pilot study. The study was initiated and carried out in close collaboration with the growers and advisors.

Approximately 40 species and varieties are evaluated in field trials. We examine questions regarding demand, productivity, harvest period, hardiness, taste, weeds, resistance to pests and disease and storage qualities. These qualities are weighed against each other, with growers evaluating which qualities are most important to them and their customers. Thereafter growers can decide which crops they prefer and are most appropriate for them.

Preliminary results have identified several perennial vegetables that are of interest as commercial crops. Other vegetables which have some good qualities are rejected due to one or more poor qualities.

Key questions concerning demand and harvest remain and will be answered in the final year of the study. Results from this pilot study can be used to indicate species and varieties that are worth cultivating and for future studies.

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Keywords

Perennial vegetables, field trials, farmer-led research, biodynamic/organic market gardens

What do we feed when we feed? CSA, biodiversity and social web

***Thacya Cledina da Silva Pilon*[1], *Lucas Contarato Pilon*[2]**

[1]*AEDAS/MG (State Association for Environmental and Social Defence), Contact: thacyacledina@gmail.com*

[2]*Dr. Ing. Agronomist, Autonomous technical adviser, Contact: pilonlucas@yahoo.com.br*

Research question
What do we feed when we feed? (question emerged by a co-producer during meetings)

Research method(s)
This is a report of a Community supported agriculture, CSA São Lucas, of those members (producers and co-producers), food in agricultural life cycles, biodiversity and food health. This CSA aim was share principles, foods and learning collectively. For building a community of people that seek a balanced and harmonious life with nature resources and agroecosystems.

It was started in November/2017 by family of São Lucas Farm, a farm as biodynamic organism, Nova Venécia city - ES/Brazil. The farm is characterized by a biodiversity of crops in agroforestry system. From reports, observations and learnings, administrative notes and many harvests, the historical report was presented from Nov/2017 to Jan/2020. In 2020 the CSA was finalized to develop a new phase (here is another timely report).

Results
The community involved 20 co-producers families, initially only São Lucas Farm (two families), then there was the inclusion of four family farm, and made up this collective (figure 1). All the people´s farms were members of the Veneciana Agroecology Association, an association of organic small farmers. Among the families of co-producers, initially were all from Nova Venecia City, after involved family of 2 more neighboring cities.

According to food offer and agricultural produce, vegetable predominated, mainly fruits, horticulture, grains (e.g. beans, corn and rice) and agro-industrialized foods (e.g. jellies, breads and dehydrated fruits). Animal food only honey and chicken eggs. During the year, the total food diversity was 83 types (figure 2). Weekly have 10 to 12 types of food, throughout the year could feed on a wide variety, each season its harvests (figure 3). In the spring (sep. to dec.), fruits mainly, fruit and agro-industrialized vegetables, in the summer (dec to mar) higher offerings of fruit and horticulture fruit, in autumn (Mar to jun) greater supply of leafy horticultures and grains, at the end of autumn added the harvests the citrus fruits and beginning of horticulture roots, in winter (June to September), mainly horticulture roots and leafy, and agro-industrialized.

Conclusion
The CSA São Lucas provided a participatory and systemic social structure with successfully and replicable, each region with its social individuality. Non-existent until then in the Espirito Santo/Brazil, as new possibilities with farmers & consumers (co-producers).

Keywords

Socio-economic system, farming systems, food systems, seasonal food

Influence of different feeding systems to quality of beef

Vilma Zivatkauskiene[1]

[1]vilma.zivatkauskiene@lammc.lt

This research has confirmed that grass-fed beef contained 7.3 times more conjugated linolenic acid as compared to the grain-fed beef. The same could be said about omega-3 fatty acid. Even though beef is not the best source of omega-3, grass-fed beef might contain 2-4 times more of this acid than grain-fed beef. This has also been confirmed by Lithuanian research. Hence, the ratio between omega-6 and omega-3 is better in grass-fed cattle. The better this ratio, the more beneficial effect to the health. Grazing cattle move a lot and feel less stress. Their meat has less fat and is more healthy.

Keywords

Meat quality, animal husbandry, grassland

Milk processing and allergy in mice models

Dr. Ton Baars[1], *Suzanne Abbring, Mara Diks, Betty van Esch, Johan Garssen*

[1]Utrecht University, Immunopharmacology, a.baars@uu.nl

Introduction
Both in epidemiological studies in rural children (Brick et al., 2020) and a small clinical trial in multiple allergic children differences (Abbring/ Kusche et al., 2019-A) are found in allergy outcomes between shop milk and raw farm milk. Raw milk showed protection against allergic outcomes. In two studies in mice, it was investigated, which part of the milk fraction is responsible for the allergy protective effects and at which temperature of heating, the allergy protective effect is lost.

Methods
To investigate the impact of the fat-fraction and heating, mice were pre-treated by oral gavage with different milk types: whole raw milk, skimmed raw milk, heated whole milk (78^{o}C, 15 sec) prior to oral sensitisation with ovalbumin using cholera toxin as an adjuvant. To get a better view on the impact of heating, in experiment 2, mice were fed different types of milk, based on small steps of heat treatment of raw whole milk (raw, 50, 60, 65, 70, 75 or 80^{o}C) prior to oral sensitization with ovalbumin.

To compare the heat steps a fixed time of heating of 30 minutes was chosen for research purpose. In both trials the clinical reaction was measured upon ovalbumin challenge (anaphylactic shock, drop in body temperature and ear swelling) plus immunity parameters in serum and organs. Additionally, in experiment 2, also the concentration of the different milk protein composition was measured.

Results
The outcomes of experiment 1 were that similar to raw milk, skimmed raw milk suppressed food allergic symptoms, demonstrated by a reduced acute allergic skin response and low levels of OVA-specific IgE and Th2-related cytokines. Not the fat content, but the heat-sensitive components are responsible for the allergy-protective effects of raw cow's milk (Abbring et al., 2019-B). The outcomes of experiment 2

were, that a substantial loss of native whey proteins, as well as extensive protein aggregation, was observed from 75°C. However, whey proteins with immune-related functionalities already started to denature from 65°C, which coincided with the temperature at which a loss of allergy protection was observed in the murine model (Abbring et al., 2020).

Conclusions

No effects could be found between whole milk, skimmed milk and the whey fraction of milk, and therefore changes due to the allergy response are located in the whey fraction. Immunologically active whey proteins, that denature around 65°C, are of importance for the allergy-protective capacity of raw cow's milk.

Acknowledgements

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Keywords

Raw milk, heating, allergy

The potential of biodynamic farming to respond to the current crises in UK food and farming systems

***Lindsey Selleck*[1]**

[1]MSc Environmental Engineering at Cranfield University. Winner of the BDA Student Essay Competition 2021, lindseyselleck@live.com

The UK's self-reliance in food production and supply has been slowly decreasing since 1980 (Lang, 2020) and is being further affected by Covid-19 and Brexit (Moran et al.,2020).

Biodynamic farming aims to achieve resilience and regeneration, therefore has the potential to address the problems facing the UK food and farming systems. The UK has the second highest level of food insecurity within Europe (WHO, 2018).

As a result of Covid-19, it is estimated that there was a quadrupling in levels of food insecurity as a result of panic buying and economic impacts (Loopstra, 2020). Biodynamic farmers can form partnerships with local communities who are at higher risk from food insecurity in the form of

community supported agriculture to allow individuals to benefit from the production, rewards and responsibilities associated with the production of food (Biodynamic Association UK (BA), n.d.) and try to reduce the current disparities within the UK food system. With food insecurity comes dietary related illnesses (Lang et al., 2018).

Biodynamic farmed produce have been proven to provide a range of health benefits including a reduction in allergic reactions (BA ,n.d.) and the supply of greater quantities of nutrients including vitamin C (Crinnion, 2020), iron and magnesium (Larion, 2009).

By improving the health of individuals, wider benefits may be seen when looking at the strain currently experienced by the health services. Biodynamic farming techniques can enhance the fertility of soil (Fliessbach et al., 2000), therefore by implementing such techniques, the UK can continue to produce food for an extended period of time, increasing its resilience.

Biodynamic farming focusses on each farm being self-sustaining, consequently, adopting these methods can reduce the reliance on imports of food from different countries, which has the potential to be affected by Brexit and border challenges (Lang et al., 2018).

The UK has a 20-year vision on antimicrobial resilience which can be achieved using biodynamic farming due to their view of using antibiotics only in cases of preventing suffering of livestock (BA, n.d.).
Furthermore, this enhances the health of the animals which can ensure their efficacy for future generations, thus providing a steady supply of food. Biodynamic farming techniques can be adopted as a response to the many challenges currently facing the UK food and farming systems whilst providing wider economic and environmental benefits.

Keywords

Biodynamic farming, Covid-19, UK food resilience, food insecurity, Brexit, Environmental Land Management schemes, food insecurity, antibiotic resistance.

Autonomy in biodynamic and agroecological practices: a crop path for quality of agroforestry robusta coffee

Lucas Contarato Pilon[1], *M.Sc. Thacya Cledina da Silva Pilon[2]*

[1]pilonlucas@yahoo.com.br

[2]AEDAS/MG technical adviser, email: thacyacledina@gmail.com, address: Manuel Pereira Delfino Road, zip 35460-000, Brumadinho, MG/Brazil.

Research question
What are the strategies and practices provide soil life, biodiversity and food quality in a robusta coffee crop?

Research method(s)
This is a report of a year planning for a coffee crop, developed and applied in 2020. With the aim to advance in biodynamic agriculture of robusta coffee (*Coffea canephora* Pierre ex A.Froehner) under agroforestry system, to improve healthy quality for coffee bean.
This research was developed on São Lucas Farm, a family farm in Nova Venécia City, ES/ Brazil. The farm is a biodynamic organism since 2014, initially using the fladen, 500 and 501 biodynamic preparations, then compost with biodynamic preparations, thus far Hugo Erbe preparations (HE#8 Three Kings and HE#9 Harmonizing). The preparations were

self-produced, exception are compost preparations (502 to 507).

The farm has the characteristic of biodiversity crops in alley agroforestry system, the robusta coffee is the main crop.
At the beginning of the plan (August/2019) after harvest, is characterized by dormancy period, in this time the agroforestry trees were pruned and the plan was started. Thus the practices were systematized:

- Pruning and canopy opening of agroforestry trees (biomass production for soil cover);
- Hoemopathy for coffee leaf rust (*Hemileia vastratix* Berk. and Broome) and plant health: two applications of Kali Carbonicum and Rust Nosod, through drip irrigation;
- Conservation of green cover of the soil with native grasses and perennial peanut: cut the cover crop on "flower" days and ascending moon, three times in the year (image 2);
- 500 and Fladen preparation - three applications each, respectively 100 and 150 gr./ha: in the september/post-flowering, december/filling of grains and february/green grains;
- 501 preparation - 3 applications of 4 grams/ha, the last 9 days before the harvest start (March/2020). The latter practice suggested by Masson, 2009.
- coffee harvested predominantly on "fruit" days. The post-harvest of coffee fruits consists washing (separation of ripe, green and dry grains), and drying in farmyard with sunlight. After coffee processing, samples were taken for sensory analysis of the SCA scale (Speciality Coffee Association).

Results
In coffee leaf rust management, controlled plant´s disease, and the leaves recovered. The main difference observed in fruits was less affected by diseases and less bean defects. The sensory classification of coffee SCA, 2019 sample the score was 75 points and the 2020 harvest was 82 points, increase quality. The comparison of this report is based on the 2019 observations in farm.

Conclusion
The set of practices promoted the balance in the farm organism as a whole, bring increase results in each practice carried out.

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Keywords

Biodynamic preparations, biodiversity, biodynamic agriculture, coffea canephora.

Multifunctionality of small farms in arid zone for food security and sustainability: Case study from Pali, India

Dr. Dheeraj Singh[1]

[1] ICAR-Central Arid Zone Research Institute, India, Krishi Vigyan Kendra, dheerajthakurala@yahoo.com

The paper describes the case study of Mr Mangilal living in hot arid zone of Thar desert of India who with his hard determination and organic principles turned his deserted farm in a green economy. As his land was barren, soil was saline and low in organic

matter ,weeds were major problem he decided to go for multifunctional agriculture and convert his farm into an organic farm. He started with levelling of land and preparing his field in summer by deep ploughing and making deep ridges so that he can trap maximum rain water in his field for the upcoming crops.

He followed crop rotation as the basis of his farming system as crops are grown naturally without external inorganic inputs (Singh and Singh., 2017). The crops are grown in a 3-crop rotation and a very unique crop rotation devised is Wheat, Mustard, Cumin, Greengram system in which mustard residue acts as disease controller for the wilt and blight in cumin crop along with good yield of major crop and nitrogen requirement is covered by legume.

Besides field crops incorporation of spice crops mainly cumin, fenugreek, fennel and ajwain plays a very important role in farm sustainability as spices are disease resistant, hardy, requires less water and nutrients and play a major role by providing food and shelter to variety of insects and pollinators. Mr Mangilal also reared cows and goats of local breed which are the most important component of Crop-animal integrated farming.

The farmer practice composting for organic waste management and uses a variety of organic materials in composting process such as straw, crop residues, fallen leaf litter and kitchen waste. Under rainfed conditions he practice intercropping of green gram with sorghum and sesame which reduces the climate-driven crop failure as variety of crops have different climatic adaptability.

Intercrops efficiently utilize the natural resources and nutrient and increase biodiversity, productivity, resilience and stability of agroecosystem (Ning et al., 2017). The main crops are pulses, spices, barley, oats and wheat. The farm fields are bordered by safflower margins. These margins prevent run-off of minerals from the field into bordering ditches. These practices have built soil organic matter and the soils are now self-enriched. In general, the crops give 20-32 percent higher yields without any chemical fertilizers.

Acacia trees planted on farm boundary acts as biological fence and as sink for carbon dioxide and store excess carbon as biomass. The integration of trees with crops is an age-old practice to exploit the ecological and economic interactions of the different components (Coulibaly et al., 2017).

The farmer is satisfied to cultivate organic crops at his self-sustainable farm which are economically beneficial too. Alternative agriculture integrating different components with farming seems to be capable of producing sufficient yields by maintaining crop-fodder-livestock -forest plant diversities (Wolfe, 2011).

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Keywords

Deep ploughing, crop rotation, soil organic matter, organic, sustainability

Accessing the Peripheral Forces

Guy McCarthy[1]

[1]guy@twelvestar.com

A central tenet of biodynamic agriculture is that various stages of plant development are influenced by environmental energies from deep space, aka the cosmic periphery. This concept presents a challenge to growers because the so-called peripheral forces and their formative qualities are not widely known.

To address this challenge, additional emphasis must be placed on education. An experimental means to demonstrate the reality of peripheral forces would be ideal. Is it possible to collect peripheral forces using a selective antenna, and demonstrate a beneficial effect on plant development?

Research Methods

A collector of environmental energy was devised based on a dielectric cavity resonator. This type of antenna is typically used to receive microwave energy and was selected because the earth is bathed in such energy from distant stars. Resonators were coated with selective materials to create an emissive surface. It was hypothesized that specific peripheral forces would be derived from environmental energy and emitted from these surfaces.

Experiments were conducted indoors under a humidity dome in which light, temperature, and moisture were carefully controlled. Cat grass seedlings were cultivated in glass columns allowing root development to be observed and photographed. Treated plants were exposed to the dielectric resonators. Control plants were shielded from the resonators by a sheet of dense plastic. The shield was positioned directly beneath the grow lamp, effectively dividing the light source, and ensuring that both sides received the same amount.

Results

In multiple trials treated plants exhibited a significant increase in root development, as shown in photographs. When green shoots were trimmed and weighed, treated plants showed an increase in biomass of 15%.

Conclusion

The data suggest that peripheral forces related to root development were derived from environmental energy using resonators with a copper coating. It was assumed that forces related to upward growth were derived using resonators with a chromium coating. Treated plants exposed to these forces sequentially, or in combination, exhibited a corresponding.

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Keywords

Education, peripheral forces, cosmic radiation

Pfeiffer Circular Chromatography: contributions to the analysis of soil health in biodynamic agriculture areas

Ph.d. Fernanda Silveira Franco[1], *Carlos Eduardo Barros[1], Maria Rodrigues dos Santos[2]*

[1]Federal University os São Carlos, Environmental Sciences Department ,Center of Science and Technology for Sustainability, Contact: +55 19 97169 8233 fernandosf@ufscar.br

[2]Horto Bela Vista - Lote Mãe Terra, farmer certified Demeter (PGS/ABD) – Member of Brazilian Association of Agricultural Bodinamic - +55 15 99145-4534 – email: marrodsorocaba@hotmail.com

Soil degradation is a process resulting from the management adopted by industrial agriculture, which configures an environmental and social crisis, in the countryside and in the city. In the midst of such a context, agroecology as a movement, science and practice, values the diversification of food production while respecting the ecological and social conditions of a territory.

In order to implement this agriculture proposal, it is essential to have methods to assess the impacts on soils resulted of agroecological and biodynamic practices adopted in agricultural organisms.
Pfeiffer Chromatography is a comprehensive diagnostic tool for the soil quality, the method of which is simple and inexpensive.

The present paper aimed to understand the state of soil health in four land uses in a biodynamic site certified by the Participatory Guarantee System (PGS) of the Brazilian Biodynamic Agriculture Association.

The areas evaluated were: an agroforestry system with vegetables, an area of planted banana in which green manure were cultivated, a fallow area and a remaining forest, in a family farmers area in the Iperó municipality, São Paulo state.
For this, the Pfeiffer chromatography method was used and the physical-chemical attributes of the soils were examined.

The qualitative and quantitative outcomes obtained are enough to state that the soils of the forest area and the agroforestry system are the healthiest and are similar in several aspects. The agroforestry area, due to the presence of a great diversity of tree species, which provides diverse ecosystem services, and the use of biodynamic preparations in vegetables and plants associated, promoted improvements in the physical, chemical and biological soil qualities, captured by chromatography.

Chromatography was an efficient method for analyzing the health of tropical soils, with potential for use by family farmers, in the process transition to biodynamic management, and especially those organized in participatory guarantee systems. In this way, it is possible to follow the evolution and improvement of the soils managed by biodynamic agriculture, in its greatest objective, which is the Earth healing and the wellness for all beings.

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Keywords

Agroforestry system; agroecology; family farmers; quantitative method; tropical soils.

Evaluation of Populations of squash (Cucurbita moshata L.), under biodynamic management and participatory genetic breeding, in Botucatu-SP, Brazil.

Pedro Jovchelevich[1], *Antonio I. Cardoso[2]*

[1]Associção Brasileira de Agricultura Biodinamica, pedro.jov@biodinamica.org.br

[2]FCA-UNESP University, Botucatu, Brazil, Email: ismaeldh@fca.unesp.br

The squash (Cucurbita moshata), plant of American origin, is part of the tradition of old civilizations that colonized America and it is cultivated in many states in Brazil, mainly by familiar farmers. There are a great biodiversity of genetic material. This plant is used for human and animal feeding.

According to FAOSTAT 2009 the distribuition of squash and pumpkin in the world is: China- 353.000 ha, Cameroon -110.000, Cuba – 66.000, Russia – 54.000, Egypt – 40.000, total amount in the world – 1.556.000 há. While in Europe the legislation for organic and Demeter products prohibits the use of conventional agriculture seeds, here in Brazil, when we talk about vegetable seeds there are few options at the market. It is very important to research, develop and produce new seeds adapted to the organic cultivation.

The aim of the present work is to evaluate the income and the quality of fruits of one kind of squash, with the participatory approach and through the mass selection of four populations in three generations, in a biodynamic familiar farm in the Botucatu city, in São Paulo state, Brazil.

The experiment was lead by the local farmer Edmilson Veríssimo at Botucatu city/SP. He was a biodynamic horticulturist whose fields were certified as Demeter. The area lies at south latitude 22o44'00", longitude 48o34'00" west of Greenwich, altitude of around 900 meters above the sea level. The climate is classified as Mesotérmico Cwa, which means, subtropical humid with dry winter period. The ground is classified as latossolo red-yellow, sandy texture, distrofic. The farmer`s area is surrounded by diverse tree rows, in a riparian forest area and with extensive pasture in the neighborhood, with more than 1 km of geographic isolation from other vegetable crop areas. For the initial culture there were used seeds of four distinct populations from the research material of PhD Antonio I. Cardoso (FCA-UNESP University).

There were two experiments comparing the original seed and three cycles of selection, one in September (2009) and another in November (2009). For such, this assay was conducted through an experimental design of randomized blocks, with seven repetitions.

We evaluated the following items: Average number of fruits per plant; average weight of the fruits; total length of the neck and the bulge, and diameter of the neck and the bulge.

The results of the three cycles of selection indicate an increase in the frequency of plants with longer and fine fruits. It is observed a lesser frequency of plants with undesirable format of fruits. The results of weight of the fruits is not significant. Thus, application of simple breeding methods, such as mass selection, show a real improvement. The experience of participatory improving brings a rich knowledge for both involved - researcher and farmer

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Keywords

Agrobiodiversity, cucurbitaceae, mass selection, biodynamic agriculture, participatory breeding

Long Paper Contributions

THE BIODYNAMIC PEPPER AS A PROMISING METHOD IN THE CONTROL OF *Atta sexdens*

Maria Eugênia Gobbo Mercadante
Brazilian Association of Biodynamic Agriculture
mariagobbo93@gmail.com

INTRODUCTION

The general *Atta* and *Acromyrmex* are characterized as leaf-cutting ants (Hymenoptera: Formicidae), belong to the tribe Attini and to a monophyletic group of the subfamily Myromycine, in addition, they have a mutualistic relationship with the fungus Leucoagaricus gongylophorus (Rabeling et al., 2019). Their ecological importance is unquestionable, as they influence nature's ecological processes, such as: seed dispersal, aeration and nutrient distribution in the soil (Dos Santos et al., 2019).

In addition to their environmental importance, they stand out for being economically relevant, as they are considered one of the most harmful pests in Neotropical regions, due to their wide distribution and numerous damages they cause to agriculture (Oliveira et al., 2017). As they are generalist herbivores, that is, they cut a diversity of plants to cultivate their symbiotic fungus, they end up negatively impacting the reproductive success of plants and directly interfering in their photosynthetic capacity (Câmara et al., 2019).

The use of insecticides to control insect pests has been questioned due to the negative impacts they generate on the environment. Organophosphates, pyrethroids, sufluramids and other insecticides used to control leaf-cutting ants generate consequences such as soil and water pollution, toxicity in non-target species and harmful effects to pollinators (Londoño, Romero-Tabarez & Ortiz-Reyes, 2019). Therefore, it is necessary to replace these risky products with control methods that are effective and safe (Rodríguez, Montoya-Lerma & Calle, 2015).

Conceptualized by Rudolf Steiner in 1924, Biodynamic Agriculture goes against the chemical system. It is a sustainable agriculture system in which the producer is self-sufficient in the production of his inputs (Ram & Kumar, 2019). According to Steiner (1924), the biodynamic system nourishes the Earth so that cosmic influences flow freely, and that the more life there is on Earth, the beneficial forces help in the development of plants and animals.

In one of his lectures, Steiner (1924) developed a pest control method called "Pepper", where he burns insects, using their ashes and processing them in liquid form until dilution D8. After its preparation, the ash can be sprayed in the field, with the function of inhibiting insect reproduction (Ram & Kumar, 2019). Exceptionally for chitin carapace insects, such as leaf-cutting ants, this process must be carried out when the Moon is in the constellation Taurus, and for enhanced effect, when the Sun and Moon are in this constellation (Steiner, 1924).

It is known that the Botucatu region has a high incidence of Atta nests (Miklós, 2012) and that leaf-cutting ants have economic and environmental importance in the American continent. Thus, the objective of the work was to test the efficiency of the "Biodynamic pepper" in 4 active scouts from the same nest of Atta sexdens (lemon saúva), for a period of three Moons in Taurus (July, August and September), observing if there was a reduction in their foraging activity.

METHOD

The experiment was conducted at the Brazilian Association of Biodynamic Agriculture (ABD) in Botucatu – SP. The area has the following geographic coordinates: latitude 22°44' south,

longitude 48°34' west of Greenwich, altitude approximately 900 meters above sea level. The climate is classified as Mesothermal type Cwa, that is, humid subtropical with a dry season in the winter period, according to the international Köppen system (Setzer, 1946). The soil is classified as red-yellow latosol, sandy and dystrophic in texture.
At the Biodynamic Association site, 13 nests of Atta sexdens were recorded, 1 of which was destined for the experiment. Initially, it was necessary to verify which scouts belonged to the selected nest, and for that, the straw methodology, adapted from Forti et al. (2017), which consists of cutting small pieces of plastic straws (0.5 cm), soaking them in orange juice,

Days	Months
1.6E+18	July
12,13 e 14	August
9,10 e 11	September

breading them with soy bran and leaving them to rest for 24 hours at room temperature. The figure below shows the straws separated by their respective colors.

Figure 1: Straws separated by color before being poured into the scouts**. Photo:** Personal archive.

Parallel to this, the 4 most active scouts, that is, with the greatest foraging activity, were selected and marked with a stake by color and number. As the ants do not digest the plastic, after a few days, the straws were discarded on the outside of the nest and of the selected spyglasses, confirming that those spyglasses corresponded to the nest.

Subsequently, the "pepper" or biodynamic ash was applied as recommended by Steiner (1924). For this experiment it was not necessary to carry out the ash dynamization process from the beginning (D1 to D7), since in the Association there were ash stored up to the D7 power, originating from the 2019 flock. Figure 2 shows the dynamizations already ready.

Figure 2: Dynamizations of biodynamic pepper from Atta sexdens stored until D7. **Photo:** Personal archive, 2020.

The experiment was carried out in July, August and September 2020. The following table illustrates the days of the month when the Moon was ruling Taurus, according to the biodynamic astronomical calendar.

Table 1: Days of the month when the Moon was in Taurus. **Source:** the author, 2020.

Following the precepts of Biodynamic Agriculture, the application of "biodynamic pepper" should be carried out when the Moon is in Taurus or, when the Sun and Moon are in this constellation, for a more potentiated effect. However, the Sun only enters Taurus once a year, which did not coincide with the dates of the experiment.
For this experiment, during the three consecutive months, it was established to dynamize 400 mL of D7 in 3.6 L of water in the costal spray, daily for Taurus days. To facilitate the process, in July, 10 L of D7 was stored in a gallon, which was used in the three months of application. The validity of the dynamizations is up to 2 years.
The evaluations were made before each application, in order to count the number of ants moving with and without load for one minute in their respective selected scouts, according to the methodology of GIESEL (2007).
After counting, the application was made both in the selected spyholes and in the nest, using a 5 L costal sprayer. The temperatures and Relative Humidity (RH) were measured before each application using a hygrometer, in order to observe if there were drastic changes in these parameters.

RESULTS AND DISCUSSION

It is important to emphasize that this experiment was carried out for the purpose of observation and comparison between scouts. Therefore, there was no indication of a control for comparison purposes with the treatments (scouts).
Despite this, the data were submitted to factorial ANOVA, using the R software, and later Tukey's test, for comparison of means at 5% probability.

According to the results obtained, it can be proved that, according to the statistical analysis, there was a significant difference between the treatments (blue, green, red and black), since the Tukey test at 5% showed a significant difference between the paired means ($p = 0.00656$).
Figure 3 shows the variation of the foraging activity of Atta sexdens according to the respective days when the moon was in Taurus. The colored lines correspond to the 4 evaluated scouts, each color referring to a scout.
It is possible to observe that the blue scout differs from the others from the beginning, demonstrating greater foraging activity until the penultimate day of analysis, which corroborates its statistical distinction from the others.
Thus, it can be inferred that for the four scouts tested under the same field conditions, only the blue scout had peaks of increase in ant foraging activity, unlike the others, that from the first day of ash application there was a reduction of this activity.

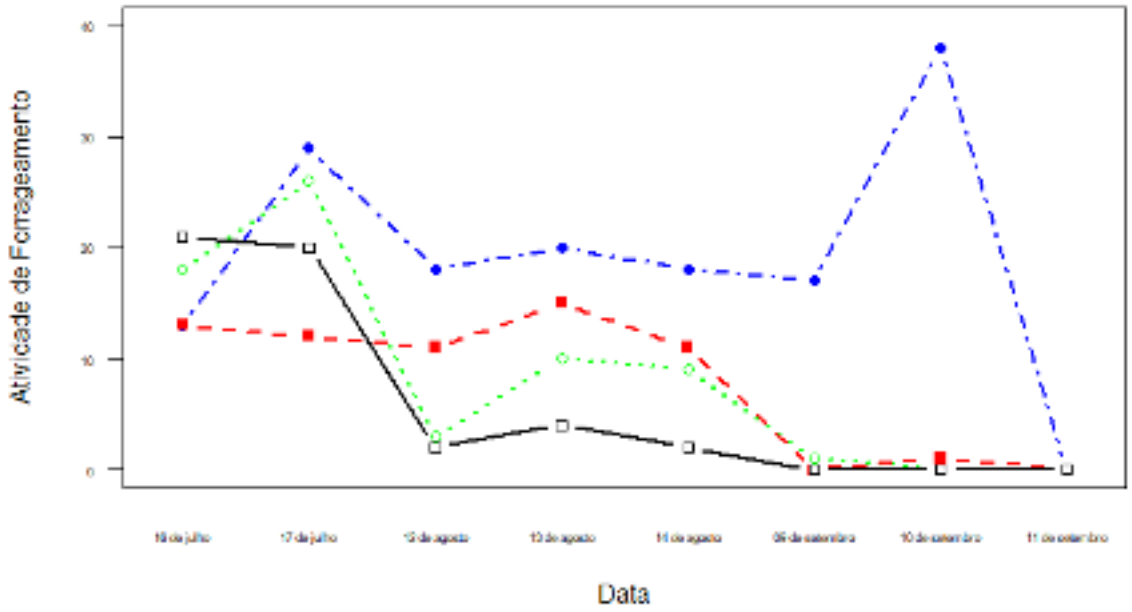

Figure 3: Graph representing the variation of the foraging activity of Atta sexdens according to the days the moon was under the constellation Taurus for the months of July, August and September 2020. The colored lines indicate different scouts. **Source:** Software R, 2021.

In Lecture 6 of the book Fundamentals of Biodynamic Agriculture, Steiner (1924) illustrates well the use of biodynamic pepper against nematodes in beetroot. When analyzing the use of this biodynamic method to control pests in agriculture, it is concluded that the pepper contains the germ of destruction, the power of fire is capable of eliminating fertility, consuming it.

For Thun (1986), pepper seems to be an excellent control method for vertebrate and invertebrate animals. Promising results were observed with the ashes of the Colorado beetle and its larvae. She points out that for remarkable results, the Sun and Moon must be in the constellation Taurus, following the biodynamic astronomical calendar.
Thun (2000) found that with the use of pepper it is possible to reduce the population of target organisms to a balanced level, as long as the constellation indicated for each animal is respected. She claims that if the application takes place in three consecutive afternoons, there is a significant reduction in its reproduction.
Making a parallel between the present study and the statements of Thun and Steiner, it is evident that pepper or biodynamic ash can be an effective control method in the sustainable control of agricultural pests, as long as the indicated constellations are respected for each target organism.
It is suggested to deepen this study extending it for a period of 1 year, so that other parameters such as seasons, constellations, Moon phases, nodes, conjunctions, oppositions, eclipses, trines, perigee and apogee are evaluated and correlated, to in order to identify whether there is any direct or indirect influence of these factors on leaf-cutting ant activity.
Furthermore, it is extremely important to promote research in this area, enriching the scientific database, in order to contribute to the accessibility of knowledge to all.

CONCLUSION

The scouts that were treated with the biodynamic ash in the indicated constellations were successful in decreasing the foraging activity of Atta sexdens under the offered field conditions.

Biodynamic ash/pepper can be a good economically viable and sustainable option for Atta control in Brazil.

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Biodynamic farming: an exception to the whitewashing of indigenous agriculture?

Dr. Julia Wright[1]

[1]Coventry University, Centre for Agroecology, Water and Resilience, j.wright@coventry.ac.uk

Abstract

In 2020 and amidst the upsurge in discourse around the concept of decolonisation, a consortium of sixteen indigenous leaders and organisations released a briefing statement that urged change amongst modern ecological farming movements. Called '*Whitewashed Hope*' (2020), the critique encouraged these movements to go deeper than simply taking indigenous practices out of context, but rather to encompass the worldviews they represent and in doing so to enable the cultural and relational changes needed for humanity's collective healing. This paper takes a critical analysis perspective to evaluate the rationale of this critique against the worldview of the biodynamic farming approach. Drawing from Steiner's works as well as other biodynamic texts, it suggests that biodynamic agriculture emanates from a worldview that has affinity with those of indigenous cultures. The aim of this paper is to instigate further debate and enquiry around this important topic of whether and how to re-indigenise modern ecological farming approaches in industrialised regions of the world.

Introduction

Biodynamic farming, along with organic farming, permaculture, agroecology and regenerative agriculture, are all modern ecological approaches to food production that arose over the last century as rational alternatives to industrial farming. Various authors contrast the industrial farming approach of yield maximisation, use of chemical inputs, and ecosystem suppression and control, with the ecological approach of yield optimisation, crop diversification and the synergistic integration of natural processes (e.g. IPES-Food, 2016; van der Ploeg et al., 2019; Röling and Jiggins, 1998).

In doing so, almost all these ecological farming approaches claim to draw from the indigenous knowledge and farming systems of Southern countries, and to combine these knowledges with modern scientific advances. The early organic pioneer Albert Howard and others in the organic movement had been heavily influenced by observing sustainable farming practices in other parts of the world (e.g. see King, 2004). Miguel Altieri describes agroecology as a "*culturally acceptable approach as it builds upon traditional knowledge and promotes a dialogue of wisdoms with more Western scientific approaches*" (Altieri and Toledo, 2011: 599). Permaculture's co-founder, Bill Mollison, attributed much of what he created as 'permaculture' to what he learned from the indigenous people of Tasmania and others around the world (Fox, 2009).

It is these claims that have led to a recent critique by a consortium of sixteen indigenous leaders and organisations which states that regenerative agriculture and permaculture offer only narrow solutions to the climate crisis. Called '*Whitewashed Hope*' (2020), the critique encourages what it terms 'Western' farming movements to go deeper than simply taking indigenous practices out of context, but rather to encompass the worldviews they represent and in doing so to enable '*the deep cultural and relational changes needed for humanity's collective healing*'. Mashingaidze touches on this worldview in his critique of the impacts of colonialism on African Indigenous Knowledge Systems (2016: 25), "*For indigenous peoples, the land is the core of all spirituality and this relationship to the spirit of the earth is central to all the issues that are important to indigenous peoples today*".

This paper singles-out biodynamic farming as potentially bucking the trend. Paradoxically, rather than claiming to draw from indigenous cultures, the knowledge base of biodynamic farming – primarily one set of lectures called the Agriculture Course –- was transmitted solely by the Austrian philosopher Dr Rudolf Steiner (1861-1925). Although Steiner was influenced by German mysticism, theosophy, Gnostic Christianity, the Cathars, alchemists, Buddhism and Hinduism, amongst other traditions (McKanan, 2018), and in particular the works of Johann Wolfgang von Goethe, he primarily explored the spiritual worlds (Courtney, 2005) and his lectures were based on his insights and inner visions from these spiritual exercises. "*I bore a content of spiritual impressions within me. I gave form to these in lectures, articles, and books. What I did was done out of spiritual impulses.*" (Steiner, 1928: 316). Steiner proposed a path of knowledge called Spiritual Science through which one could engage in a journey of discovery to explore the existence of an objective, intellectually comprehensible spiritual world, accessible to human experience (McDermott, 1984). As a highly developed seer, the concepts resulting from his own spiritual investigations he called 'Anthroposophy', meaning 'wisdom of the human being'. Emerging from this context, biodynamic farming views the farm as a holistic entity, a microcosm in physical form of the macrocosm of the physical, ethereal, and astral form of the spiritual universe (LeVasseur, 2014).

Could biodynamic farming have an affinity with the type of worldview that the contributors to '*Whitewashed Hope*' are recommending?

Method

A critical analysis approach was chosen for this study, this social science method allowing for the critical reading of a piece of text, whereby the structure is analysed and the main concepts or ideas identified, followed by the evaluation of the text using a particular hypothesis. This was undertaken in three stages: (i) the document '*Whitewashed Hope*' (*WH*) was broken down into its component concepts; (ii) the analytical question was asked: *is there any evidence of an affinity between these concepts and those underpinning biodynamic agriculture?*; and (iii) said evidence was documented to support the deductive case being made.

Results

The *WH* critique identifies six key areas of divergence between the worldviews of Western cultures from which the modern ecological farming approaches arise, and those of indigenous cultures. These areas can be summarised as: the contrast of dualism versus monism, dead matter versus the consciousness of all life, the notion of good and bad versus a relational striving for balance, the limitations of languages, the need to consider the historical relationship of people to land, and the interconnectedness of human-Earth healing cycles. Using the headings in the original document, these areas are listed in the left column of Table 1. For each of these, evidence from Steiner's and other biodynamic texts are proposed where an affinity suggests itself.

Table 1. Six key areas of divergence between modern Western and indigenous cultures, and the potential affinity with concepts underpinning biodynamic farming

Key areas of divergence in the 'Whitewashed Hope' document (paraphrased)	***Existence of relevant concepts underpinning biodynamic farming?***	
	Y/N	***Examples/evidence***
1. *Modern ecological farming cultures*: Nature is viewed as separate, outside, ideal, perfect. Human beings must practice 'biomimicry' because we exist outside of the life of Nature. *Indigenous cultures*: We are Nature. As cells and organs of Earth, we strive to fulfil our roles as her caregivers and caretakers. We often describe ourselves as 'weavers', strengthening the bonds between all beings.	Y	In *Spiritual Ecology* (Steiner, 2008), Steiner proposes that we are an integral part of the evolving natural world from which we arise. This world surrounds us, and we can rediscover ourselves within it, just as we can find all of nature transformed within us. Lieber et al (2006) describe biodynamic farming as trying to actively shape the unique interaction between crops, livestock and farmer.

1.Death Doesn't Mean Dead *Modern ecological farming cultures:* Maintain the 'dead' worldview of Western science: of rocks, mountains, soil, water, wind, and light. Believe that life only happens when these elements are brought together in some specific and special way. *Indigenous cultures:* View the Earth as a communion of beings and not objects. All matter and energy is alive and conscious. Mountains, stones, water and air are relatives and ancestors. Earth is a living being whose body we are all a part of. No 'thing' is ever dead; life forms and transforms.	Y	"*when speaking about the four elements of earth, water, air and fire…. it must be stressed that everything of a solid, earthen nature has as its foundation an elemental spirituality. …when knowledge is no longer obtained by means of combining abstract, logical thoughts, but by uniting ourselves through our thinking with the world rhythm, then we shall rediscover the elemental beings contained in everything of a solid earthy nature*." (Steiner, 1922) "*Truly, the farm is a living organism*." (Steiner, 1929:7)
1.From Judgemental to Relational *Modern ecological farming cultures:* Maintain overly simplistic binaries through subscribing to good and bad. We must do only the 'good' things to reach the idealized, 99.9% biomimicked farm/garden, though we will never be as pure or good 'as Nature', because we are separate from her. *Indigenous cultures:* Often share the view that there is no good, bad, or ideal—it is not our role to judge. No one is tainted by our touch, and we have the ability to heal as much as any other lifeform.	Y	In *Spiritual Ecology* (Steiner, 2008), Steiner proposes a conscious equilibrium with nature whereby we are not entitled simply to exploit the Earth, but neither should we view ourselves as devastating irritants on the Earth's surface. The Agricultural Course was given as an approach of healing or spiritual renewal in response to farmers' questions about the depletion of soils and a general deterioration of crops and livestock (Steiner, 2004).

1.Our Words Shape Us *Modern ecological farming cultures:* Use English as their preferred language no matter the geography or culture. The English language judges and objectifies. English also utilizes language like 'things' and 'its'. *Indigenous cultures:* Every language emerges from and is therefore intricately tied to place. To know a place, you must speak her language. There is no one-size-fits-all, and no words for non-living beings, because all life has equal value.	Y	Steiner wrote about what he called '*The Genius of Language*' (1995). He felt that German was more useful to put across esoteric meaning than English. He wrote about the relation of a people's language to its soul life, and of differentiations of language according to geographical conditions.
1.People are Land. Holistic includes History *Modern ecological farming cultures:* Claim to be holistic in approach, however, tends to exclude history. *Indigenous cultures:* People belong to land rather than land belonging to people. Healing of land must include healing of people and vice versa. Recognizing and processing the emotional traumas held in our bodies as descendants of assaulted, enslaved, and displaced Peoples is necessary to the healing of land. Returning our rights to care for, harvest from, and relate to the land that birthed us is part of this recognition.	Y	In the Agricultural Course of 1924, Steiner emphasised that agriculture touched on every aspect of human life (Steiner, 1993). He proposed three ideals expressing three social spheres: equality, freedom and cooperation. Biodynamics began in the context of this threefold vision of social justice. Steiner also wrote and lectured extensively on human health and healing, e.g. Steiner, 2013a, b, and many biodynamic farms also include social elements around therapy and therapeutic education (McKanan, 2018).

1.Composting *Modern ecological farming cultures:* Often share the environmentalist message that the world is dying and we must 'save' it. Towards this mission, we must put Nature first and sacrifice ourselves for 'the cause'. *Indigenous cultures:* See Earth as going through cycles of continuous transition. We currently find ourselves in a cycle of great decomposition. Like in any process of composting there is discomfort and a knowing that death always brings us into rebirth. Recognizing and healing all of our own traumas is healing Earth's traumas, because we are one.	Y	In *The Cycle of the Year as a Breathing Process of the Earth* (1984) Steiner writes of the Earth's cycle of inbreathing and outbreathing. In *Dying Earth and Living Cosmos - The Need for New Forms of Consciousness* (2015) he reflects on the Earth's transition and speaks of extending and deepening our connection with the world and the cosmos as conscious and fully human co-creators. Steiner also wrote extensively about human reincarnation and soul evolution, e.g. Steiner, 2013c.

Discussion

It was not difficult to find relevant material from Steiner's collections; he was a prolific writer and orator with over 300 volumes to his name (Turgeniev, 2003). In fact the challenge would be to identify and select the most pertinent texts from within this body of work, with this preliminary study barely scratching the surface. Nevertheless, the evidence in Table 1 demonstrates that for each of the six key areas of divergence between modern, Western ecological farming approaches and indigenous worldviews, a positive association or affinity can be found with the philosophy underpinning the biodynamic farming approach. Such affinity does not necessarily mean that all biodynamic farming practitioners hold or concur with the philosophy proposed by Rudolf Steiner, nor that all biodynamic farming practice demonstrates the underpinning concepts. As far back as 1928 (4 years after the Agriculture Course was delivered), a conscious decision was made to separate the biodynamic method from its underpinning Anthroposophical origins in order to attract a broader range of farmers to its practice (Paull, 2011). Yet there remains today a strongly held, familial relationship between national and international Anthroposophical and biodynamic organisations, with the biodynamic movement being coordinated by the Section for Agriculture at the Goetheanum, Switzerland. According to its website, the Section also has a seat on the board of the Biodynamic Federation – Demeter International (BFDI), the international umbrella organisation thus unites all Biodynamic and Demeter standards and certification bodies worldwide.

These philosophical and conceptual threads of Anthroposophy and Spiritual Science that run through biodynamic education, research and practice are important to this discussion in relation to the aforementioned other modern, ecological farming movements. The agroecology movement in particular has positioned itself as representing and defending small-scale,

indigenous farmers and their knowledge systems worldwide (van der Ploeg et al., 2019; Rosset and Altieri, 2017). Yet a recent paper argues that although this movement includes many farmers' organisations whose indigenous members live according to their cultural worldviews, its taught curriculum, like those of the permaculture and organic farming movements, sits firmly within the Western cultural philosophy of its dominant proponents (Wright, 2021). Whilst the agroecology movement laudably defends the need for a plurality of epistemologies in order to embrace local cultural and ancestral knowledges (Nieto Gómez et al. 2013), the document *Whitewashed Hope* demonstrates that a diverse range of indigenous representatives can come to agreement over a shared set of trans-cultural, philosophical concepts. These shared 'truths' are explained by Steiner as being the concepts by which we access the world's inner nature. When combined with our individual perceptions that reflect the outer appearance of the world, we may achieve (and even create) a fuller picture of reality (Steiner, 2011).

Conclusions

Does this mean that the Western agroecology, permaculture and organic agriculture movements should look to contemporary indigenous cultures for a more appropriate philosophical framework or worldview than the one they hold at present? The contributors to *Whitewashed Hope* encourage them to "*Learn whose lands you live on, their history, and how you can support their causes and cultural revitalization*." For European cultures, their history and their land is (also) deeply scarred, by repeated colonisations, as well as by being the heartland of scientific 'Revolution' and industrialisation (Baring, 2020; Clunies-Ross & Hildyard, 2013). For modern ecological farming movements in these regions then, clues to an expanded philosophical framework may be found in the histories and contemporary revivals of the Druidic, Celtic or other indigenous cultures (Greer, 2011). At the same time, the case of Steiner and biodynamic farming demonstrates that a neo-indigenous philosophy and worldview, and an accompanying reconnection and healing with the land, may be created in real-time through the experiential practice of conscious enquiry, using an appropriate methodology of the kind offered, though not exclusively, by Spiritual Science.

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Grasping the Whole – Biodynamic Hermeneutical Knowledge

PhD Sofi Gerber[1]

[1]Skillebyholm Biodynamic Education Centre, Research, sofi.gerber@skillebyholm.com

Introduction

Biodynamics is often stated to be a holistic way of farming. At the very core of biodynamic agriculture is the concept of farm individuality, where each farm is seen as a self-sufficient system with its own characteristics (Steiner, 2004). The different parts of the farm in form of soil, plants, animals and even people are seen as organs that together build a farm organism. But what does this really mean in agricultural practice? What kind of knowledge and skills are needed to farm in a holistic way and how are these abilities developed?

In Bortoft's description of Gothean science, the Whole is always more than the sum of the parts. The Whole is something in its own, but it is not a thing than can be observed or grasped in the same way as physical entities. Since the Whole is no thing, it is often perceived as nothing, and is therefore being ignored as if it would not exist (Bortoft, 2018). Although the holistic perspective is inherent in biodynamic principles, it is often overseen even in biodynamic research in favour of more reductionist research perspectives and methods (Brock et al., 2019).

My research, partly financed by *Signe and Ane Gyllenberg foundation*, investigates how biodynamic farmers in Sweden relate to the farm individuality in their daily work. The purpose is to investigate what different forms of knowledge biodynamic farmers apply in practice on their own farm. The hypothesis is that biodynamic farmers possess valuable tacit knowledge when it comes to developing life processes in circular systems, rather than optimizing inputs and outputs in linear systems that are the norm in conventional cultivation. The study applies phenomenological methods, where the researcher follows biodynamic farmers in their daily work. Through semi-structured interviews (Kvale, S & Brinkman, 2014), participant observations of daily work in the form of shadowing (Gunnarsson, 2019) and walk-and-talk conversations (Vereijken et al., 1997), I examine the tacit knowledge developed by the farmer in relation to his/her farm organism.

In this paper, I concretise three different aspects of farmers' tacit knowledge in relation to the Whole: observation, the time-space dimension and the upstream movement. The aim of the paper is to visualise how these aspects of Wholeness come into being through concrete practices that are fundamental, but not exclusive, for biodynamic farming.

Observing

"The most important skill for a farmer is to observe", one biodynamic farmer stated confidently. Standing next to the milk pit, I added that this might be even more important when you work with animals, but she said, "It is always important." The ability to observe, and the routine to do so, is often stressed by the farmers. "The knowledge of the farmer is on his boots" one farmer explained, thereby stressing the importance of being there, in the fields in a very concrete way. You need to walk the fields to know how to cultivate them. This farmer had the routine to go out once a week, just to observe without doing any practical work. "But", he said with a smile, "I do this on Sundays because otherwise people would wonder why I am not working."

To do a phenomenological study through shadowing is to walk in the farmer's footsteps. When heading from the packhall to the greenhouse one gardener told me: "Sofi, let's take this way instead" pointing in the opposite direction. This way was at least twice as long as that through

the garden and it led us on a meandering path through the nearby forest. “I use to take this way because here I can observe the seasons in such a good way”, he explained. One could think that a gardener experiences the seasons all the time, but it is obvious that this little detour adds an extra aspect to the observations made during the practical work.

Lifting the observation out of the routine work seems to be a common practice, be it in form of a little detour, a farm walk every morning or an observation moment once a week. In biodynamic farming, this also has ontological aspects, since in the relationship between man and the world is not seen as an I-Thing-relationship, but rather as an I-You-relationship which has ethical and esthetical implications (Leiber, 2009). Therefore, the observations are more than collecting information about the situation in the farm. It is also about building a relationship to the farm in its parts and as a Whole.

Although Gothean science and practices to develop your observational skills are fundamental in biodynamic agriculture, the farmers in my study rarely mention this explicitly. The development of your relations to the living beings of the farm seems to be a subtle question that you seldom address explicitly (Von Diest, 2019). Rather it shows itself in small actions and comments along the way. Therefore, as a researcher in this field, you also have to develop your observational skills and develop a relation to the persons and processes you are studying to be open and awake for what is not explicitly expressed.

The time-space dimension

In biodynamic farming, place is most important. The most characteristic of the biodynamic is the holistic perspective, where the farm is seen as a living organism (Steiner, 2004). The farmer is part of this organism and is also involved in the development that takes place on the farm. It is thus not possible to separate the farmer from the farm he/she works on, but the development of knowledge takes place in relation to the place and the place is developed based on the farmer's knowledge (de Vries, 1995; Klett, 2012).

As the geographer Doreen Massey has shown, place is not a static thing, but is being constantly recreated and is therefore always to be seen in relation to time (Massey, 2005). I have found that the biodynamic farmers in my study move and act in this time-space in a way that is difficult to describe in an explicit way. Still, this ability to handle time and place as a Whole, that is constantly in flux, is fundamental for the farming practice. We will take the crop rotation as a concrete example.

“Why can’t anyone explain the crop rotation in a clear and understandable way?” one of my students in biodynamic farming asked after one of our many farm visits. Every time we visit a biodynamic farm, the students ask about the crop rotation of that specific farm and each farmer answers promptly what crops they have, and in which order the follow on each other. I never saw any farmer consult any paper or computer when answering this question, but everything was available in that very moment. The students are trying to take notes at the same speed as the farmer is talking and usually someone asks for a clarification and the farmer repeats the crop rotation again.

It took me some time until I realised that some people try to grasp the crop rotation from a space perspective, that is how the different crops are distributed on the fields in one specific year, whereas others understand it from a time perspective, that is how the different crops take turns in one specific field. In the mind of the experienced farmer, these two perspectives seem to merge into one time-space-entity that is not so easy to make explicit in an understandable way. Through the practice of crop rotation, the parts of the farm in form of separate fields and the different crops constitute a Whole that is more than the sum of its parts (Bortoft, 2018).

Therefore, when the students ask the farmer about the crop rotation, they might expect an explanation of an explicit system that is easy to understand. Instead, they get a description of the farm organism as it expresses itself through the crop rotation that the farmer has developed an ability to grasp as a Whole.

This relationship between farmer, land and crops is developed over time and through different techniques. When looking at the artistically designed crop plan hanging over the coffee table together with an experienced biodynamic gardener, it becomes obvious that this is a never-ending process. He remarks that usually, he draws the plan together with his wife, but this year, she did it on her own. This gives him a strange feeling and he does not feel as related to how the crops are situated in the field as he uses to do. Massey's statement, that place is recreated over time is very well manifested in the biodynamic farm with its crop rotation, where the fields are changing from year to year. This process goes also in the other direction, since also the farmer is formed by the co-creative process in relation to the farm organism. When this gardener is not actively involved in one aspect of the co-creative process, he immediately experiences this as a loss of connectedness.

Another example of that the crop rotation is not a one-sided process comes from another biodynamic gardener. While we are working in the field, I ask her about their crop rotation. Her immediate answer is that they have a "free eight-year crop rotation" where they of course must keep track of certain crops, such as cabbage. Then she adds: "For example, the garlic found its place here", pointing at a row close to the swedes we are harvesting. At first sight, this description, together with the concept of "free" crop rotation might make you think that this farmer does not take crop rotation very seriously. At further consideration, it rather points at an important aspect of the dynamics of the crop rotation. It is not something that is created in the head of the farmer, which could be exchanged by an excel sheet, but it is something that is created in relation to the land and the crops on that very farm. It is a truly co-creative process.

This dynamic aspect of the crop rotation is hard to explain theoretically, but since I put the question while we were standing in the field it was easy for the farmer to point at a crop that had "found its place" in the crop rotation. Therefore, an important condition to be able to catch this kind of tacit knowledge is to be in place and in the flow of the farm organism itself, rather than sitting at a table conducting a traditional interview. By "shadowing" the farmer in his/her daily work, the situated knowledge can be articulated more easily (Gunnarsson, 2019).

The upstream movement

One observation that struck me when shadowing the biodynamic farmers in their daily work was that they were very present in the tasks they were accomplishing, using their different senses to fulfil their tasks in a confident way. At the same time, they were moving back and forth in time in relation to the phenomenon they were facing at the moment. For example, when harvesting the lettuce, the gardener reflects on how the plants has developed in relation to how they were planted out into the field earlier in spring. As he moves along the rows of tomatoes, he plans which varieties to seed next year depending on the health of the plants he is passing by. These considerations do not influence the speed in which the practical tasks are fulfilled, but rather seem to be an integrated part of the work. I was not sure how to analyse this aspect of practical knowledge until I met the concept of moving *upstream*, as defined by Henri Bortoft (Bortoft, 2012)**.**

The biodynamic farmer is working within the field of life processes. This might seem like an obvious statement, since animals are living beings, plants grow and die and lately even the soil is considered to be a living organism by more and more scientists and practitioners. In his/her daily work, the farmer is standing in the middle of this life stream. Using the concept of Bortoft

(Bortoft, 2012), I call the practice of relating to these life processes the upstream movement. This is something different then the explicit cause-and-effect paradigm that we are used to think with in Western society. While the cause-and-effect thinking is more mechanical – if I do this, that will happen – the upstream movement of the farmer has more to do with following the life stream, of which one is a part. It is about being aware of how things come into being, rather than focusing on the end product in a reductionist way.

The upstream movement is the ability to see where a plant comes from as well as the potential of a seed developing into a plant and at the same time being aware of your role as a facilitator in this process. Rudolf Steiner has described how the ego, in the material mode of cognition which we use in daily life, creates images of what it perceives that last longer than the perception of the object. The ego also links concepts, thereby making judgements that help us navigate in the world (Steiner, 1993).

Through the repeated work throughout the seasons, the farmer creates images not only of the objects with which she/he is working but is also developing an ability to create such images of the living processes on the farm. As one farmer puts it, she can hold the small lettuce seed in her hand and when seeding it in spring at the same time see herself selling that luscious lettuce head to a customer at the summer market. This imagination includes the ability to grasp the potential living forces of the seed as well as what is needed for it to develop into a head of lettuce. Therefore, the upstream movement of seeing how something comes into being is promoted by the repetition of the seasons and deepened from year to year.

Conclusions

In working with the living, the biodynamic farmer is in a process of coming into being. This process takes place on different levels at the same time, including the observation of a single plant while harvesting it, reflecting on how it was planted and if it should be done differently and constant adjustment of compost and biodynamic preparations practices. This leads to farmer self-reflection on her/his own knowledge in relation to the development of their farm. In their daily work, the farmers use a kind of imagination that is not abstract but is developed through practical work throughout the years. The experiences from earlier seasons nourish the imaginative forces and the ability to see how things come into being.

Biodynamic farming is a hermeneutic process in which the farmer moves between parts, from the bigger picture of grazing and crop rotation down to details of routine daily work. These observations lead to adjustments in understanding the whole, which in turn put the details in a new perspective. But, unlike a hermeneutic text analysis where the analysed object is at hand, the farmer is co-creating the wholeness – the farm individuality – that he/she relates to. In that sense, farming practice contains both reflexive and imaginative aspects, even though these are often tacit and not explicitly articulated.

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BIODYNAMIC CERTIFICATION IN BRAZIL

M.Sc. Rayan Scariot Vargas[1], *Andréa Cristina Dorr[1], Jéssica Righi de Oliveira[1], Fernando Silveira Franco[2]*

[1]Federal University of Santa Maria, Department of Agricultural Education and Rural Extension at the Center for Rural Sciences ,Post Graduation Program of Rural Extension, Contact: +55 55 9997-1978 rayan_scariot@hotmail.com

[2] Member of the board of the Brazilian Association of Agricultural Bodinamics and the Brazilian Association of Agroecology. Associate Professor at UFSCAR, Campus Sorocaba. - +55 14 99795-8630 - e-mail: fernando.agrofloresta@gmail.com

INTRODUCTION

One of the direct consequences of the 1924 Agriculture Course was the creation of the Experimental Circle (EC), a group organized at the request of anthroposophists dedicated to agriculture, such as Carl von Keyserlingk (1869-1928) and Ernst Stegemann (1882-1943). The participants gathered in the CE elaborated suggestions for the biodynamic preparations, carrying out in this way, experiments and developing the teachings transmitted in the Agriculture Course. To start with, this knowledge would be worked internally by the Natural Sciences Section of the Goetheanum, however, the demand for such knowledge, both by farmers and consumers, led to the dissemination and expansion of the principles, and the Experimental Circles grew with the support of the Section of Natural Sciences.

As a result of this expansion, in 1927 the Polish Erhard Bartsch (1895-1960) together with the German Franz Dreidax (1892-1964), who at the time were the main leaders of the Experimental Circle, created a seal to identify agricultural products developed using Biodynamic Agriculture, the Demeter seal. Based on Steiner's book "Mystery Knowledge and Mystery Centers" (1923), which addresses the myth of Demeter, its mysteries, its trimembration, and its connection with agriculture, in 1928 Dreidax formulated the first standards for quality control, also considered the first organic production standards.

The certification process was a legal milestone for Biodynamic Agriculture because, through this standardization process, the principles first proposed by Steiner for agriculture were legitimized. Through this aegis of legality, the associations and institutes of the biodynamic movement managed to establish themselves and grow during the 20th century, resulting in a worldwide movement, especially after the Second World War.

Brazil was one of the countries that welcomed Biodynamics and developed its history, with its particularities and trajectories, where the certification process has a prominent role in understanding the Brazilian biodynamic reality.

Therefore, this research seeks to understand the Demeter certification process in biodynamic agricultural organisms in Brazil during the year 2019, elucidating its trajectory, situation, certification models, the role of institutions, and the limits and potential of the Demeter seal for the development of agricultural units, according to the perception of actors linked to the Brazilian biodynamic movement.

METHODOLOGY

To fulfill the proposed objectives, this article used qualitative research involving the collection of descriptive data and understanding the phenomena according to the subjects' bias. A descriptive study on the certification process was also carried out, as well as bibliographical research developed mainly through books and scientific articles.

The semi-structured interviews were the main source of field data collection and were crucial for capturing the experiences and perceptions of the agents who make up and build the Biodynamic reality in Brazil. Thus, the interviews had the participation of members of the associations, inspectors and former inspectors of certifying institutions, and biodynamic farmers certified or not with the Demeter seal. To review the historical construction of the Demeter seal in Brazil, going through different views on existing certification models, and perceptions about the limits and potential of the process.

In identifying the interviewees, we search to categorize them between farmers and non-farmers, and within the group of farmers whether they had Demeter certification or not, and also the type of certification. This categorization sought to preserve the identity and privacy of respondents, since the Brazilian Biodynamic universe is still very young, which facilitates the recognition of its agents. Therefore, for non-farmers, the nickname N. FARMER was used, and among farmers: those without certification: UNC. FARMER; only by pgs FARMER PGS; and with the two models: FARMER AUD. PGS.

The article in question is an excerpt from the master's thesis entitled "Certification in the Counter-Hegemonic Construction of the Demeter Product Market: Biodynamic agriculture under the aegis of legality", defended in 2020 by the Postgraduate Program in Rural Extension at the Federal University of Santa Maria and carried out with financial support from National Council for Scientific and Technological Development (CNPQ).

RESULTS AND DISCUSSION
BIODYNAMIC CERTIFICATION SITUATION IN BRAZIL

Currently, Brazil is one of the 19 member countries of the Biodynamic Federation Demeter International (BFDI), with 24 registered agricultural units using more than 3 thousand hectares. With 28 processors, 22 producers, and 2 commercial operators with a diverse production of crops and processed products, such as: 35 varieties of fruits, 7 types of grains, 9 of vegetables, 39 vegetables, 5 types of oils, 2 types of nuts, 37 varieties of herbs and spices, and a variety of pasture, as well as other crops such as flowers, aloe vera, sugar cane, hops, and coffee. The processed products are cosmetics, essential oils, dry products like dried fruits, coffee, instant mixes, sweeteners, preserves, fresh products like butter, salad packets, fruits and vegetables, beverages like wines, juices, and pulps. In addition to dairy farming with dairy products and beekeeping.

But the dimension of Biodynamic agriculture in Brazil is even greater, as there are biodynamic agricultural units that do not have the Demeter certificate, however, they have incorporated the practices and principles offered by Steiner. Currently, Brazil is a reference in the Demeter certification process since it has two certification models: the one audited by IBD, which according to Bauermann (2019, p. 7) is considered the largest organic certifier in Latin America; and the Participatory Guarantee System (PGS) carried out by the Brazilian Association of Biodynamic Agriculture (ABD) and by the Brazilian Association of Biodynamic Farmers of the South (ABDSul).

THE HISTORY OF BIODYNAMICS IN BRAZIL

The Biodynamic was introduced in Brazil by German farmers who left their country of origin in 1939, a time of expansion of the Experimental Circle and full dissemination of Steiner's principles throughout the world, with the creation of associations in several countries. However, with the rise of the Nazi party, Biodynamic practices were formally banned in 1941 in the hunt for so-called "esoteric" philosophies. (STAUDENMAIER, 2010, p. 216). Thus, this group of farmers practicing Biodynamics urgently traveled over 9,000 kilometers in 1939 to settle in Brazil, however, their agricultural practices on Brazilian soil were only implemented in 1973, with the purchase of the land that established the Estância Demétria in the municipality of Botucatu. This acquisition was carried out by Joaquim and Pedro Schmidt, Jorge Blaich, and Marco Bertalot.

Two groups of people came together to give birth to Estancia Demetria in 1973/74. On the one hand, those who would later found the Tobias Association in São Paulo and, on the other, a group of young people who would take over the day-to-day activities of Estância Demétria. The first group created the conditions and the second found in these the opportunity to realize the ideals that motivated these two groups. Anthroposophy as a path of knowledge, with an emphasis on Biodynamic agriculture and the search for social innovation, was the main ingredient that left its mark on this seed that wanted to sprout. (BERTALOT, 2004, p. 1, our translation).

The project of a community, of a cultural island, with time, gained followers, and the Estância area was expanded by the purchase of land from its neighbors in a commitment to agriculture free of pesticides and industrialized inputs. According to Bertalot (2004, p. 2), the Estância had more than 100 employees, and in the vicinity of the neighborhood, it housed the Biodynamic Institute Association (IBD), the first and largest Brazilian certifier with more than 3,000 certified producers and internationally recognized, in addition to the Brazilian Association of Biodynamic Agriculture (ABD), responsible for research in the area, as well as courses, lectures, and consultancy that disseminate Steiner's agricultural principles.

ABD was the first Biodynamic association in Brazil and has been carrying out activities to spread Biodynamics, with this, it carries out consultancy for Biodynamic and organic agriculture in 10 states in Brazil, reaching more than 350 agricultural units. It also establishes partnerships with public and private institutions for research, education, and extension projects, in addition to carrying out the PGS certification process according to organic and Demeter standards, currently having 27 Demeter producers.

Biodynamics in the southern region of the country is represented by the Brazilian Association of Biodynamic Farmers of the South (ABDSul), founded in July 2001. ABDSul has also carried out the Biodynamic and organic PGS certification process since 2013, currently, it has 4 agricultural organisms certified by Demeter and others in transition.

Representing the northeast region there is the Association of Biodynamic Agriculture of the Northeast, ABDNordeste, founded in 2004 and linked to ABD and ABDSul, which carries out consultancy, research, courses, and training, and publication of works related to Biodynamics.

AUDIT CERTIFICATION

The first guidelines for Biodynamic production, according to Dal Col (2008), were adaptations by the International Federation of Organic Agriculture Movements (IFOAM), the German DAP, and Demeter International, carried out by a group of farmers linked to the biodynamic movement, during the period 1986 to 1989. “The first certification carried out by the IBD took place in Ilhéus, Bahia, in an area with about 2,000 ha of cocoa. A volume of 30t of the product was exported to Germany, for the company Euroherb”. (DA SILVA; NETO, 1997, p. 107, our translation).

In 1995, the Biodynamic Institute for Rural Development separated from the Tobias Association and acquired the accreditation process from IFOAM. Since then, it has expanded its range of competence for food certification, working with different standards and institutions from different countries.

Due to the high demand for the certification service and the conflict of interest in an institution that performed both consulting and the certification process, in 1999 a split occurred that engendered the Biodynamic Institute Certification Association (IBD) responsible for the certification part, and the ABD responsible for spreading Steiner's agricultural practices. (LÔBO, 2019). The headquarters of the IBD was then moved to the urban center of the city of Botucatu, while that of the ABD remained in the Demétria neighborhood.

The audit carried out by IBD about the Demeter seal is considered external, as it inspects regulatory compliance in other institutions and also by third parties. "Each certified production unit must present a record of the type of production that allows obtaining information to carry out necessary checks on production, storage, processing, acquisitions, and sales." (OLCZEVSKI; COTRIN, 2013, p. 462).

For this purpose, the auditors carry out field visits and use Demeter's standard requirements to carry out their inspection of compliance, and annually undergo a course to update the standards and BFDI itself conducts an annual audit at IBD.

CERTIFICATION BY THE PARTICIPATORY SYSTEM

The PGS within Biodynamics was started in 2011 with the accreditation of the ABD for the Demeter and organic system, however, only in 2013, the PGS was consolidated. Currently, ABD has 11 groups using this model and more than 60 male and female farmers in São Paulo, southern Minas Gerais, and in embryonic form in Paraná. In November 2016, ABDSul was accredited by the Ministry of Agriculture, Livestock, and Supply (MAPA) for the PGS certification process.

Agricultural units that are certified with the organic seal are advised from the beginning that the focus of the process is that they will be certified as Demeter in the future, however, farmers are not required to make the transition or remain in the process. One of the ways of keeping in the group only agricultural units interested in Biodynamic production is the requirements required for the ABD organic seal, as they are more rigorous than the common organic certification. “We can be more demanding, not less. The requirements are on the way to Demeter certification, we'll let you know in advance if people want to join, we're open, but if they don't, there are several options today”. (N. FARMER VI).

Considered a pioneer of this bureaucratic certification model, Brazil incorporated the PGS into its legislation on organic and biodynamic production, giving it the same validity as third-party certification, and its conceptual structure was developed from the workshop entitled 'Certificação Alternativa' which was held in Brazil in 2004, as a result of the efforts of the Ecovida agroecology network and sponsored by IFOAM/MAELA. (IFOAM, 2008; MEIRELLES, 2010).

The PGS is structured through a network of relationships woven by the legality of the certification process, it involves a Participatory Conformity Assessment Body (OPAC) that provides the connection and legal representation of the other agents in the process before MAPA. The OPAC is composed of representatives of regional groups, a consumer, and a representative of the collaborating institution (ABD and ABDSul in the case of Biodynamic agriculture), and is responsible for the actions and is legally responsible for the actions taken by the PGS, since it is passive for audits and inspections of the MAPA, to this end, they hold the documentation referring to the groups that compose it.

For a new group of farmers to join the PGS system, 70% of producers must have biodynamic practices, with a period of one year for the conversion process, in addition, producers have to frequently participate in training and studies technicians of Brazilian legislation. The costs related to the participation of groups are defined by OPAC and must be used in the administrative process of managing the certification. For example, in the annual election of an Evaluation Committee that manages the field visits, which are carried out at least once a year in each agricultural unit, in addition, this committee establishes the final opinions that are sent to the MAPA.

PERCEPTION ABOUT THE BIODYNAMIC CERTIFICATION PROCESS

Potentials and Limits

Perceptions about the potential of the biodynamic product certification process were summarized in four themes: market access; product enhancement; improving agricultural practices; and greater organization of production.

Concerning the market, it was stated that obtaining the Demeter seal works as a guarantee for access to the formal market and, consequently, an increase in the income of the agricultural unit. “Having a seal means entering a market. Today, according to the data given to me, there is a lot of biodynamic product missing, everything that is produced using Biodynamic is sold, but it can only go if someone guarantees”. (N. FARMER II). The Demeter seal was related to adequate remuneration, as it adds greater added value to the product, ensuring greater support for the productive exercise. Compared to the organic seal, in addition to not using synthetic inputs that give a negative weight to the financial balance of the agricultural unit, biodynamic practices ensure a higher average production. (BELUHOVA-UZUNOVA; ATANASOV, 2019; PECHROVÁ; VLASICOVÁ, 2013).

One of the interviewees describes that the Demeter regulation can work as a growth tool for farmers, as it expresses knowledge first transmitted by Steiner and later developed over decades by farmers all over the world. “This part is really cool, when I started to produce, instead of taking a book on agronomy, I took the normative book that gave me directions on how to produce by learning to manage from the regulation itself”. (FARMER PGS).

For me, the certification process is a management process, independent of the protocol. If it's an organic protocol, if it's a sustainable protocol, if it's a biodynamic protocol, like the entire certification

process, it requires records. Producer's knowledge of the standard, then producer's knowledge of his production system. Nobody has this knowledge better than him, we, as inspectors, don't get there giving an opinion on his production, because he understands it better than we do. For me, certification expands and does not limit. (N. FARMER IV).

Another point is the organization of activities. By completing the necessary documentation, farmers and farmers carry out a reflective process on the daily activities that build their reality. “The certification process is a process that helps organize information, I think. You should have everything written down. It has to have a history, so in that sense, I think it helps the organization”. (N. FARMER VI).

Regarding the possible limits on the certification process, they were listed trying not to focus on any specific model, and so they were grouped into three items, the time required, limit by compliance with the rules, and limit of agricultural units with a high diversity of products.
For the process to work fully, it is necessary to fill in production-related documents, thus ensuring the traceability of certified products. This process of filling in spreadsheets requires time from the farmers involved in the process, who in many cases have a very high capacity to deal with the agricultural practices necessary for their daily lives, however, they do not have the same familiarity with bureaucratic processes.

It also works as a limiting factor for the practices used in the agricultural unit, since by complying with the certification standards, the actors get rid of the stressful process caused by the decision, the "vertigo of relativity", since once the individual is harnessed the normative set does not need a greater process of reflection or discovery. Thus, in complying with the rules, decisions are based on the manual of rules and partly dispense with the creativity and freedom of the actors. “The certification itself, I think, brings limits. Because you have to conform to a Standard. But from the moment you want certification, you agree with this limit. They have rules and rules are limits. It's a fact for me.” (N. FARMER II).

Another limitation found by agents is obtaining basic inputs such as: seeds; seedlings; and manure; to respect production norms, this limitation was listed as a strong obstacle to the full dissemination of Biodynamics. Within the reality of some agricultural units interviewed, this point was excluded for the acquisition of the Demeter seal. In particular, when agricultural units are integrated into larger commercial circles, which demand even more inputs, which in turn are insufficient.

Certification was also listed as more appropriate for agricultural units with less product diversity, because, by certifying a highly diverse agricultural unit with a low production volume, the bureaucratic process is intensified in the registration of various activities that represent a tiny portion of the profits obtained by the agricultural unit, requiring more time and ability of the bureaucratic process. While in a monoculture the traceability of that single product represents the entire registration process necessary. "It's easier, it's simpler for you to do common certification, but Demeter is even more if you have fewer products." (UNC. FARMER I). “That's why I say certification is a necessary evil. Because it can somehow give the feeling of limitation. We should be freer or we should be more aware of what we're doing." (FARMER AUD. PGS II).

The Audited and the Participatory System

The auditing system was recognized as a landmark within the biodynamic movement in Brazil, and as an intrinsic part of its reality. As presented in the history of Biodynamic certification in Brazil, certification appears in line with the project developed at the end of the 20th century within the Demétria neighborhood. "I think it was a necessary phase for biodynamic Brazilizan

farmer to become professional, intellectualize, become able to have a sketch of the property, to have the habit of noting things down, so at that moment I think it was important." (FARMER AUD. PGS I).

Due to its international support, the audited process has the advantage of enabling the export of the certified product, thus allowing access to market structures that are inaccessible to the participatory model. “[...] today certification for export has to be by audit, it is mandatory to have an audit”. (N. FARMER VI). This relative advantage makes the audited model indispensable for institutions such as: Cooperativa CABRUCA, from southern Bahia, which exports cocoa and various fruits in addition to its derivatives; the Vale do Caí Ecological Citrus Growers Cooperative, located in Rio Grande do Sul, which exports citrus derivatives; Volkmann Alimentos Ltda, also located in Rio Grande do Sul, sells rice varieties; Mocó Agropecuária Ltda, located in Paraíba, which exports rice and mangoes, among other products.

Thus, the audited system requires professionals capable of evaluating complex systems such as food processing and, consequently, its the packaging. They are professionals with a theoretical background who undergo annual updates to the Demeter standards. “As long as a technician, a food engineer does in industry, he is an expert, so it is much easier. That's your positive side. [...] he will have a technical look, which in complex processes is better”. (NO FARMER VI).

When the process is carried out impersonally, by technicians whose function is restricted to the auditing process, it guarantees greater legitimacy to the modality, since there are no effective ties between the one who audits and the one who is audited. For one of the interviewees, personal relationships can facilitate the covering up of compliance deviations, in auditing the system can also be made up, but for the respondent, the auditor has more tools to identify deviations than in the participatory system.

However, factors that guarantee a greater scope of commercialization, greater legitimacy vis-à-vis the markets, and its historical character do not ensure preference in the system audited by the interviewees. "The negative is that the audit is done at a distance, right, it's outside, so it's not in reality, in everyday life." (N. FARMER VI).

One of the factors raised as negatives of the audited process is the cost required to maintain the system, this higher cost compared to the participatory system builds the reality that to achieve this type of certification, the agricultural unit must have a relevant purchasing power, of this way, excluding all those units that are not supported by the audited reality.

And if impersonality and formality guarantee legitimacy vis-à-vis the foreign buyer, these same characteristics end up keeping producers away from the audited process. "Audit doesn't get involved is a cold thing." (N. FARMER VI). “[...] I think it's very cold, very focused only on the market. I don't know how to say it, maybe for a big company where maybe the owner himself isn't directly involved with the thing, maybe it's the case of an audit and then he comes and does it, it's really cool [...]”. (N. FARMER III).

In addition, the audited process often does not meet the expectations of Biodynamic agriculture actors, whose origins occur in a period between wars, with the advance of totalitarian regimes, and persecution of anti-hegemonic thoughts, such as the attacks that Steiner suffered for seeing another social model. (SELG, 2017). Many of those who seek their North in Steiner's agricultural practices feel the need for farming to have an intimate connection with the social and environmental cause. This absence of a broader social and environmental commitment in the certification process creates a void, according to reports.

You see, the initial initiative was a group of farmers who built this, and then it is in the business enterprise where there is a company that makes the certification, so what happens in the current reality is quite far from its origins. I think it's a need to approach the ethical and social principles that Biodynamics proposes at its core, because otherwise, it wouldn't be necessary to come up with other labels such as Fairtrade and all that kind of thing that within the Demeter label is already more than covered. . (FARMER AUD. PGS I).

As already pointed out by Dulley (2003), auditing becomes passive to be used by agriculture concerned simply with the economic return of the activity, moving away from the fundamentals of Biodynamics and performing the practices necessary for the Demeter seal for mere market convenience.

The participatory system is perceived as a strong link of personal relationships and exchange of knowledge between agents of Biodynamic agriculture who share it. In addition to the training process that takes place in the meetings, with the reading of Steiner's works or the preparation of preparations, the relationships that are established belong to people who share many common everyday symbols and meanings.

"The participatory system is interesting, because, in addition to having this bureaucratic part, there is also this part of exchanging experiences. I think this is the great thing, to take advantage and do both. It enhances this issue of being participative". (UNC. FARMER II).
The ties formed by the PGS allow the resolution of problems directly, between those who have it and those who have already overcome them, this cultural exchange between farmers creates an environment of socialization in which the constructed reality challenges conventional market relations.

Participatory certification has a very interesting cultural nature, once the group manages to complete the stage of filling out the documentation and creates this as a very serious internal routine, very well built and consolidated, it is an opportunity for the group to really do agricultural science when they are together. So, the great opportunity for the cultural growth of the group, in the meetings of the properties, I am particularly experiencing this reality. (FARMER AUD. PGS I).

The meetings are held in the biodynamic agricultural bodies of the certification group, thus, there is a visualization of the productive stages of each of the units involved, a small immersion in different realities is possible, expanding the amount of agricultural knowledge that each one of the participants has. In addition farmers, other members of society also can come into contact with the realities of agricultural organisms, expanding the diffusion and integration with society.

"Including consumers, producers, technicians, the community of schools, even teachers who are invited to participate in meetings, visits, and participate. The most general participation, but really social". (UNC. FARMER II). "While the other model that I participate in, it allows for many exchanges, and requires us to be responsible for the process. This accountability process gives us the construction of citizenship". (FARMER S.C. III).

The participatory system, for having this range of relationships, was perceived as safer by the interviewees, since the deviation of practices can harm relationships that go beyond the market sphere. The PGS was not considered infallible, but by establishing personal relationships in which there is a deeper and more constant contact, it has a greater capacity for the members of that group to perceive the real intentions of their certification colleagues. "And the part of the checklist, which is bureaucratic for submitting documentation, ends up not giving the person

much leeway. There are a lot of documents that a person has to get in order not to contradict himself". (FARMER PGS).

However, the biodynamic PGS still does not have the same range of insertion in the markets as the audited system, especially for exports. And because it is a new system, which began work in 2013 in Brazil, they raise doubts about its reliability, as it has the presence of personal relationships, and about the system's ability to act in the inspection of complex systems that require a specific experience.

"Here at PGS for complex processes, for example, an industry, or a complex animal husbandry, it is much more difficult to do than with auditors because they are not experts in this". (N. FARMER VI). "It has to be very true not to be corrupted, I'm very afraid of corruption, 'Oh you used that, Ah, but you had to, that happened so you keep quiet and I keep quiet, because then we don't harm ourselves' ". (N. FARMER II).

According to reports, the time required to maintain certification activities requires more available time and energy on the part of its members, which can be seen as an incompatible point for some producers. "I'm currently in the participatory system, but I don't know if I'll continue to participate in the PGS, because each time I have less time and in the participatory system, you have to participate." (UNC. FARMER).

BY THE WAY OF CONCLUSION

The interviews elucidated the diversity of perceptions that build the Brazilian reality about Demeter certification, demonstrating that by approaching the themes: "certification" and "Biodynamics" we are entering a plural universe with different streams of thoughts and narratives.

Both certification systems have their relative advantages and limitations, and farmers and process agents must define their own choices and actions on which certification should be used in the agricultural body. Some points should be highlighted, one of them is the importance of the audited process that allows access and permanence of major brands in the international market for Demeter products. Another point is the existence of farmers who have both modalities of certification, and in these cases, the audit was a market necessity, and the choice for the PGS was an investment in its social character and to diffuse Steiner's principles.

This characteristic of the knowledge-sharing PGS is similar to the "*Campesino a Campesino*" agroecological method in which farmers are the main agents for diffusing agricultural practices. According to Braulio et al. (2012, p. 67), communication between equals enables the generation of knowledge which, in turn, makes authors capable of reaching actions that transform reality. Furthermore, another striking fact of this process is the report that these bonds bring farmers closer to the roots of the biodynamic movement, where its actors built a counter-hegemonic reality through the organization and sharing of symbols and knowledge.

In this way, we understand the Brazilian reality as intimately associated with the remarkable events of Biodynamic Agriculture, since the creation of the CEs that engendered associations around the world, such as the importance of the Demeter seal that guaranteed the necessary legitimacy for farmers to exercise and develop their agricultural practices under the law.

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Biodynamic Agriculture in Brazil and the relationship with trees and forests

M.Sc. Jéssica Righi de Oliveira[1], *Gisele Martin Guimarães[1], Rayan Scariot Vargas[1], Fernando Silveira Franco[2]*

[1]Federal University of Santa Maria, Department of Agricultural Education and Rural Extension , Postgraduate Program in Rural Extension, Contact: + 55 55 99973-2507 jessica_roliveira93@hotmail.com

[2]Brazilian Association of Agricultural Bodinamics and the Brazilian Association of Agroecology. Associate Professor at UFSCAR, Campus Sorocaba. - +55 14 99795-8630 - e-mail: fernando.agrofloresta@gmail.com

INTRODUCTION

The contemporary world has been marked by the worsening effects of climate change. The Intergovernmental Panel on Climate Change report, Climate Change 2021: The Physical Science Basis, (IPCC, 2021), demonstrates that we are reaching the limits of the planet. And the red alert stamps the Western civilization contingency that sought, as Mosé (2019) demonstrates, to subdue nature in its impetus for giving the last word, weaving a relationship of confrontation and negation of nature that resulted, as a legacy of modernity, both in environmental exhaustion as inhuman exhaustion, thus turning humanity into its own tyrant.

In this context, in which joint global action to contain climate change becomes urgent, as stated in the IPCC report (2021), it is understood that the relationship of human beings with nature and the conservation and maintenance of forest areas gain space as protagonists. And given the importance attributed to the conservation of natural areas, countries such as Brazil, recognized worldwide for their richness and forest diversity, stand out in terms of planning development strategies that will determine the future course of life on Earth.

However, the socio-economic history of Brazil has given this forest country prominence as a country of latifundiums, monocultures, deforestation, and environmental imbalances, current consequences of the processes of land use and occupation, always concentrated in the hands of a few. In the 20th century, the country became the stage for developmental policies, whose tonic was given, mainly from the 1950s onwards, by the model known as the "green revolution". (LEITE, 2020). This resulted both in the growth of the economy and agricultural production, as well as in the advance of agricultural production in natural areas, in the increase of poverty and social inequality. (FAVARETO, 2010). One of the reflections of this historical process of rural development is that Brazil, in addition to being a forest country and large estates, is also the country of soybeans. According to the Trase Yearbook (2018), soybeans cultivated for export are one of the most responsible for the devastation of forests in Brazil. It is in this sense that agribusiness in Brazil shows itself as a devourer of forests, an icon of the domination that human beings aspire to have over nature.

Despite this, without taking our eyes off the Brazilian countryside, when observing the biodynamic agricultural organisms in Brazil, we find the opposite reality. In addition to agricultural diversity, there is also a marked presence of trees and forests in their landscapes, in such a way that the question is: What contributions can biodynamic farmers in Brazil offer to the construction of a rural development project guided by a relationship of co-evolution between human beings and nature?

Therefore, an explanatory qualitative research was carried out, whose phenomenological approach was based on the social construction of reality by Berger and Luckmann (2016). For data collection, 16 agents of Biodynamic Agriculture in Brazil were interviewed, with the aim of capturing the perception of these farmers in order to point out some contributions from Biodynamic Agriculture for the construction of agricultural work harmoniously integrated with nature, more specifically, with the trees and forests.

In this sense, it is understood that the challenges imposed on civilization are based on the objective and subjective relationships between human beings and nature. When Mosé (2019) deals with environmental exhaustion, he does so through a critical analysis of the rationality that institutes the modern subject. "Consumerism and unlimited exploitation of natural resources are the consequence of a mistaken posture that, wanting to enjoy existence in its physical dimension, destroys it." (DA VEIGA, 2000, p. 91, 'our translation'). Therefore, overcoming these challenges requires us to think about the meanings that human beings attribute to their own actions and their daily reality, it requires paying attention to human thought. According to Bach Junior, Stoltz, and da Veiga (2014, p. 7, 'our translation'), "Steiner's entire reflection maintains a confidence in human thinking, in the latent capacities that it has and that can be awakened and developed."

Finally, it is hoped that this work will contribute to the construction of development projects that consider the relationship between human beings and Nature as a key point for environmental balance, pointing out the contributions arising from the daily toil of Biodynamic Agriculture, highlighting its potential and contributions facing the environmental context, and remembering its importance as a transformer of human thought, as a path that helps in the process of rebuilding human perception regarding the environment and everyday rural life in a sense of seeking a balanced rapprochement of human beings with the environment.

METHODOLOGICAL ASPECTS

The present work entails qualitative research of an explanatory nature, in which, to fulfill the objectives previously presented, and starting from a methodological stance based on the phenomenological theory of the Social Construction of Reality by Berger and Luckmann (2014), which takes the reality as socially constructed, we seek to understand the perception of biodynamic farmers in Brazil regarding the presence of trees and forests in agricultural organisms, apprehending subjective aspects responsible for engendering everyday practices concerning trees geographically present in their daily toil agents.
Thus, the technical research procedures of the present work were carried out in two directions, namely:

- The conduction of bibliographical research on themes about Steiner, Anthroposophy, modernity and human thought; The advent of Biodynamic Agriculture; and the advent and institutions of Biodynamic Agriculture in Brazil;
- The field study, according to Gil (2008), is based on direct observations in the daily environments of the agents under study and on interviews with key informants to capture a sample of the explanations and interpretations that support this reality.

The field study took place in three different federative units, respectively São Paulo, Santa Catarina, and the Rio Grande do Sul, southern and southeastern regions of Brazil. Data collection from the agents in question was carried out from June to December 2019, using tools

such as observations and interview scripts. The analyzes and inferences about the empirical data were supported in analysis categories, where a relational perspective was taken.

It is noteworthy that this work is the result of a master's thesis entitled The Contributions of Brazilian Biodynamic Agriculture to Sustainable Rural Development: Trees and forests in the daily life of rural life, carried out by the Postgraduate Program in Rural Extension at the Federal University of Santa Maria, having been carried out with the support of the Coordination for the Improvement of Higher Education Personnel (CAPES).

RESULTS AND DISCUSSIONS

Steiner, Anthroposophy, Modernity and Human Thought

As Steiner (1928) reports in his bibliography, he was born on February 27, 1861, in Kraljevec, Croatia, the son of immigrants from the forested areas of southern Austria. Due to his high interest and dedication to understanding the works of Goethe, in 1889 Steiner (1928) received an invitation to work on the Goethe edition in Weimar, Germany, and in 1890 he received an invitation to work permanently at the Goethe-Schiller Archive in Vienna. According to Gidley (2012, p. 1) "In 1900, he began what has become known as his anthroposophical work, which continued until his death.". Miklós (2019, p. 16, 'our translation') describes that:

Steiner systematized the gnosiology contained in Goethe as a scientific basis for the development of the Science of Spirit or Anthroposophy, also built by him. From such a scientific basis, he conceived the spiritual foundations for application in the main fields of human activity.

Anthroposophy, according to Steiner (2010), is a cosmovision, a content of life, of love for life, from which we have the foundations of spiritual science. Unlenhoff (2011) refers to Steiner's position in the field of human sciences ('Geisteswissenschaft') of his time, late 19th and early 20th century, explaining that this was not limited to researching the activities of the human soul and cultural achievements, but it also encompasses the studies of health, natural, economic, social, and spiritual sciences. Lanz (1988) explains that Anthroposophy recognizes the influences of the Cosmos, being then a spiritual science, which does not deny the discoveries of natural sciences, but considers these discoveries incomplete, presenting, like other sciences, not only answers or preaching blind faith, but rather a method and a cognitive path to obtain knowledge based not only on the sensory dimension but also building a knowledge-based on suprasensory perception.

Steiner (2010) believed that knowledge from Anthroposophy, the Spiritual Science, would foster a much more complex and profound view and understanding of reality, different from the mechanistic science view of the project of modernity and knowledge from rationalist science, which in addition to they did not contemplate the whole, they had no purpose bring healthy prosperity to human beings and planet Earth. Manifestations of this thought can be found in the works of several thinkers linked to Anthroposophy:

Materialistic science is entirely based on the analytical method, of separating into parts (nowadays splitting the atom and the nucleus), of disintegration and separation, of fragmenting and all those procedures that are compelled to destroy and divide to work on the corpse instead. to help things grow, develop and synthesize. The fact is that the human spirit is imprisoned by these methods of dissection that, as I understand, is the cause of our current situation. (PFEIFFER, 1958 apud SELG, 2016, p. 57)

Despite their disagreements, Rudolf Steiner never denied all knowledge of the mechanistic naturalists, he was passionate about astronomy, mathematics, physics, etc., but strongly opposed to their empty and purely physical and sensory ways of apprehending life, he understood that while humanity sought to apprehend Nature by mechanical means, it ended up condemning the existence of nature, including its own species.

In the same sense, Steiner (2010, p. 223, 'our translation') stated in 1924 that "Man will have to break with a past of 20 to 30 years, having, for this, to deconstruct an abyss behind him; things need to be accepted according to life.". Anthroposophy generated contributions in various fields of knowledge, including agriculture, one of the last anthroposophical movements that Steiner had seen emerge, passing away a year after its advent.

The advent of Biodynamic Agriculture

Biodynamic Agriculture emerged within a group of farmers and other agents directly or indirectly linked to the field of agriculture, who, according to Bonilla (1992, p.17, 'our translation') were "[...] terrified by the fact that diseases and degenerations of plant varieties and animal breeds were on an alarming increase.". What was happening at the time (the mid-1920s) was that agriculture was undergoing transformations never before experienced by rural communities. Selg (2016) reports that materialistic science was rising in the field of agriculture, introducing not only new substances, such as chemical fertilizers but also new ways of thinking about agriculture, which would be designed based on science positivist and profit, culminating in new ways of doing agriculture, where traditional knowledge no longer fits, making obsolete the intimate relationship of sensitivity that farmers of other times had developed with the environment around them.

This group formed by farmers and other agents also linked to agriculture, according to Selg (2016), had a differential concerning this transformation process in the field of agriculture, which was marked by the incompatibility of this new model of scientific-industrial agriculture concerning the philosophical doctrines they had, based on Anthroposophy. In response to the wishes of these farmers, Steiner held in 1924 a series of 8 conferences, held on a farm in Koberwitz, covering issues relating to the relationships between soil, water, vegetables, animals, the formative forces of the etheric and astral, the cosmos and the activity of the human being (Ego) in nature (KOEPF; PETTERSON; SCHAUMANN, 1983, p. 11).

The final product of this process, the result of these eight conferences, resulted in what Rickli (1984, p. 8, 'our translation') explains as having been "[...] the first alternative to emerge since techno chemical agriculture was outlined in the last century.", or also according to Selg (2016), the final product of this process, the advent of the Agricultural Course, forms the basis of the biodynamic method, perceived in this work as necessary paths for the construction of knowledge, a reading of nature that makes it possible to think about a Rural Development that is in fact sustainable.

Due to its Anthroposophical basis, Biodynamic Agriculture can be understood as a hermeneutic amalgamation between spirituality and materiality linked to agriculture, proposing a new vision of reality, which does not deny the advances obtained by modern science, but which is concerned with uniting the potential of these sciences to discoveries of the supersensible, building a holistic view of the reality of the larger organism, planet Earth, through a new perception built not only through changing thought structures, but also through truly practical constructive action.

In this sense, Olsen (2014) demonstrates that Biodynamic Agriculture plays an important role in the ecological sphere and that its popularity has been growing due to the interest in holistic values associated with specific and rigorous standards, since Biodynamic Agriculture, making use of a closed method of nutrient cycling, limits the use of external resources to the agricultural organism, which makes Biodynamic Agriculture a precious solution to the problems posed by industrial agriculture and the context of climate change.

From the emergence to the consolidation of Biodynamic Agriculture, Selg (2016) draws attention to the role of farmers involved in this process. It is understood that there is a diligent and dialectical relationship between the agricultural knowledge passed on by Steiner and its social base, the agents of Biodynamic Agriculture. And it was through the immigration of German farmers to Brazil that Biodynamic Agriculture crossed the ocean and established its 'tempered' roots in tropical lands.

The advent and institutions of Biodynamic Agriculture in Brazil

Although Schmidt (2004), one of the forerunners of the method in Brazil, reports that the first Biodynamic farm was located in a suburb of São Paulo in the possession of Max Ruegger, even in the 60s, it is considered that Biodynamic Agriculture, legitimately proven, appears in Brazil with the foundation of Estância Demétria in 1973, in the city of Botucatu - SP. Bertalot (2004) explains that two groups were responsible for founding Estância Demétria, highlighting the work of brothers Joaquim and Pedro Schmidt and childhood friends Jorge Blaich and Marco Bertalot, the precursors of the Biodynamic Agriculture movement in Brazil.

Ambrosano, Guirado, and Azevedo Filho (2002), when presenting the history of ecological agriculture in Brazil, report that Estância Demetria is the oldest entity of this (ecological) movement in Brazil, being also responsible for the creation of the Biodynamic Institute (IBD), founded in 1981. Regarding the IBD, the ASSOCIAÇÃO BRASILEIRA DE AGRICULTURA BIODINÂMICA (ABD), informs that in 1984 the IBD received the name Biodynamic Institute for Rural Development, having previously been called Centro Demeter (1982 - 1984), having received the new name when a group of anthroposophist began to dedicate themselves to adapting Biodynamic Agriculture to tropical lands, conducting research, courses, and publications, also working in conjunction with the Associação Beneficente de Tobias (ABT).

Furthermore, the ABD (2019) states that in 1991 the organic and biodynamic certification process began, in the face of the Demeter seal, an activity that began to demand and concentrate all the energies of those involved in the then IBD, which was not yet dedicated only certification activities. Thus, the ABD (2019) reports that in 1995, intending to promote Biodynamic Agriculture in Brazil, the then Associação Brasileira de Agricultura Biodinâmica was created, already independent of the ABT, but still linked to the extinct Instituto Biodinâmico de Desenvolvimento Rural, of the which broke up in 1999.

Regarding this split process, ABD (2019) informs that the Instituto Biodinâmico de Desenvolvimento Rural started to dedicate itself only to the certification process, under the new name of the Associação de Certificação do Instituto Biodinâmico (IBD). Still, about the ABD, the ABD (2019) informs that the entity turned exclusively to consultancy and technical assistance activities in Biodynamic agriculture, aiming to promote, develop and generate Biodynamic Agriculture throughout Brazil. However, currently, this entity performs consultancy, technical assistance, research and also has a Participatory Guarantee System (PGS).

Biodynamic Agriculture in southern Brazil, specifically in the states of Santa Catarina and the Rio Grande do Sul, in turn, also has the support and strengthening of its activities through the Associação da Agricultura Biodinâmica do Sul (ABDSul). According to ABDSul (2020), the entity emerged in June 2001, intending to propagate Biodynamic Agriculture in the southern region of Brazil, even promoting, since 2013, a participatory certification system, or Participatory Guarantee System (PGS), which seeks to encourage both the exchange of knowledge and practices on Biodynamic Agriculture among its agents, as well as ensuring compliance with the regulations provided for in the legislation, advising suppliers and promoting certification services.

The institutionalization process of Biodynamic Agriculture in Brazil further legitimized the various innovations that Biodynamic Agriculture brought with it, not only in relation to the wealth of knowledge contained in its theories, or in relation to agricultural practices adapted to the Brazilian climate and soil types, but also innovations within the institutional/bureaucratic field, when dealing mainly with the Demeter Production Standards, which take into account a wide range of environmental factors, which must be respected by each agricultural organism, so that it can receive the seal of Demeter production, and among these environmental factors, the importance of conservation and presence of forest areas stands out. According to Demeter Production Standards, ABD (2015, p. 1, 'our translation'), "Agriculture is the expression of an active formative encounter between Humanity and the natural world.".

Schmidt (1986) defends the importance of working with trees and forests in Biodynamic Agriculture, explaining that forestry and agroforestry management are important for the construction of ecosystems suitable for life since the presence of these arboreal and shrubby organisms enhances the sustainability of the organisms alive. Thus, it can be presumed that in the daily work of Biodynamic Agriculture, a lens for reading reality is claimed, through which the agents in evidence develop in co-evolution with nature, also acting against the process of dissociation between human beings and nature. This lens of claiming reality, this symbolic universe, the set of meanings attributed to the reality of daily toil of agents of Biodynamic Agriculture in Brazil, as already exposed, is the main object of the empirical research of this work.

Perceptions and practices of agents of Biodynamic Agriculture in Brazil in relation to trees and forests: Fragments of the results obtained and analyzed

As can be seen, Biodynamic Agriculture transcends the mechanistic notion of agriculture, being not only a method of production of food or other agricultural products, but enjoying great transformative potential, as a path that helps in the process of rebuilding human perception in relation to to the environment and everyday rural life, in a sense of seeking a balanced rapprochement of human beings with the environment, something considers as necessary to forge a civilization that does not deny scientific and technological advances, but that knows how to critically select which fruits of progress from the modern era to incorporate into its cultural structure, in order to rebuild a society in harmony with Nature, whose habits and meanings sustain a co-evolutionary relationship with Nature.

Thus, the researcher's gaze fell on the Modus vivendi regarding the non-geographic community of agents of Biodynamic Agriculture in Brazil, thus seeking a vivid demonstration of the transformations and conditions in which agents belonging to this community produce their reality, apprehending the interpretations and the management practices that these agents carry out in relation to trees and forests that integrate their lives, that is, seeking to investigate and identify the social construction of Biodynamic Agriculture in Brazil in relation to trees and forests.

Among the sixteen agents interviewed, fifteen Biodynamic Farmers participated, ten of which were directly linked to Anthroposophy and four Institutional Agents from Biodynamic Associations in Brazil and IBD. Still, of these four institutional agents, it was reported that three practice Biodynamic Agriculture daily so that these agents were also considered as farmers. But what makes a farmer be considered a biodynamic? The sixteen agents interviewed were asked about this. The answers were free and later grouped and categorized. It was observed that the answers hover over subjective and objective universes, demonstrating that the meanings surrounding being a biodynamic farmer transcend practical issues. Of the fourteen groupings of categorized characteristics, only four concern the technical part, namely: Complying with the norms/Certification, seeking a balance with Nature, using the Agricultural Calendar, and making use of Biodynamic Preparations. Thus, it resulted that ten of the characteristics presented are endowed with subjective values and meanings, demonstrating that the symbolic universe of Biodynamic Agriculture is mostly occupied with issues that permeate agricultural issues, but that is not limited to them.

From these characteristics, it was learned that the philosophies and principles within the Symbolic Universe of Biodynamic Agriculture are of great importance for the designation of an individual as a biodynamic farmer or not. It is also noticed that the issues of Human Being/ Nature and Human Being/Earth are highlighted in the construction of these individuals and that issues related to spirituality and the cosmos form a background woven by these agents. It stands out too the characteristics related to developing and identifying each agricultural organism as unique or seeking a balanced relationship with Nature and the Earth, thus demonstrating its importance in the daily work of Biodynamic Agriculture and the social construction of its agents.

In an attempt to apprehend the set of practices and perceptions of these agents concerning trees and forests, we sought to identify what the interviewed agents apprehend about the relationship of trees and forests with agriculture. The responses obtained were grouped according to six categories of analysis whose frequency can be seen in Table 1.

Table 1 - Apprehension of the agents' perceptions in evidence about the relationship between trees and forests and agriculture.

Categories Raised	Energy and ecological balance	Soil nutrition	Physical Chemical Aspects of Soil	Astrality	Nutritional quality of food	Vegetal Reproduc-tion
Number of agents	16	6	6	6	3	2

Source: The author

As a result, it was found that these agents positively apprehend the presence of trees and forests in agricultural organisms, having all agreed that trees, forests, and agriculture maintain a complementary relationship with each other.

Given the existing diversity among Biodynamic Farmers, typification was also carried out within that group based on the importance attributed to ecological sustainability issues given decision-making regarding “productive choices” being above or below market issues. Of the fifteen biodynamic farmers, fourteen were linked to markets, and one did not consider market

their produce. Among the fourteen farmers linked to the market, eight stated that ecological issues came ahead of market demands or possibilities, and five, although concerned with environmental issues, concerns about the economic sustainability of the organisms had greater weight. In this sense, it is worth noting that the relationship with the market is an important factor for the "productive choice" of agricultural organisms.

The practice of Biodynamic Agriculture, in this sense, is daily confronted with the influences of the external society, which does not attribute the same meanings to the events of everyday reality. Thus, many of the agents in evidence need to adapt to pre-existing market demands to become economically sustainable. The need or not for certain practices will shape the habit of everyday life, which will be, within the possibilities, more or less harmonized with trees and forests.

In its entirety, the interviewed farmers have a direct relationship with trees and forests in the daily toil in agricultural organisms, and it was also learned that they all have a set of meanings that support the presence of native arboreal vegetation in their organisms, resulting in different meanings and motivations to maintain them, meanings that range from logical, biological or legal explanations, or even philosophical meanings that support a non-earthly universe. It is also noticed that in the reality of Brazilian Biodynamic Agriculture, there is a strong presence of trees within agricultural organisms, highlighting it from other forms or types of agriculture, even if ecological.

In this sense, the conservationist potential of agricultural organisms is highlighted, since it was found in all participating organisms the presence of forest patches (large or small), conservation areas, preservation or reserves, or the presence and use of native trees or forest sets integrated to the organisms and daily practices, but that do not makeup forests. The latter demonstrates the future potential of Biodynamic Agriculture in Brazil to draw even closer to forests and also the ecological weight that the non-Geographic community of Brazilian Biodynamic Agriculture bears on its back due to the provision of various ecosystem services a characteristic that was found in 100% of the participating agricultural organism.

The agents in evidence were asked about the general use or not of the biodynamic preparations, as well as the direction of use towards the trees and forests of each agricultural organism. It was apprehended that the use of preparations was not only considered important by 100% of the agents interviewed but were also verified as habits belonging to the daily toil activity of this community, appearing in 100% of the organizations participating in the research.

Still, when asked about trees and forests, it was unanimous that the application of the preparations is not aimed at them, but that in the act of applying the whole organism is looked at, with emphasis on crops, considering that trees and forests receive preparations in the same way, often by drift, because within the holistic approach of Biodynamic Agriculture, all components are interconnected and are important in shaping the whole and its individuality.

It was possible to notice that within the usual practices of the community in evidence concerning trees and forests, in addition to the use of pruning being considered common, covering 50% of the interviewed farmers, there was also an emphasis on the use of tree Paste, with 57 % of interviewed farmers indicated its use. Of those who use it, 62% do it sporadically and 32% routinely. One of the agents in the evidence brought to light the motivations for the biodynamic paste to have been developed and adopted by many biodynamic farmers:

"And then there's this vision that Rudolf Steiner brings about what trees are in nature. He says the tree is a raised earth. And the Branches, the green sprouts, grow on the tree as if they were an annual

plant rooted in the cambium and the bark of the tree. It's... the same thing as having a flowerbed, a field full of life, it's the same thing as a lying tree."

In this sense, the biodynamic tree paste enlivens the soil, but the tree-trunk type soil. The knowledge of the existence and potential of the biodynamic paste was pointed out by all the agents in evidence. Still, the use of the paste was pointed out as being directed to fruit trees, since in general, the habit of pruning in native trees, spontaneous vegetation, or inside forests, was not perceived as something normal within the community.

The application of Fladen, which aids the decomposition processes of organic matter and is, therefore, an important ally in agroforestry systems due to its role in the soil nutrient cycle, seems to be still timid, being exercised by 28% of the interviewed farmers. It is believed that this biodynamic innovation does not have such practical acceptance due to market issues, as well as not having, within the certification requirements, any mention of this practice. Still, about the relationship between Fladen and forests, one of the agents reported that when Fladen is applied to the body, the aroma of the forests is sweeter since Fladen makes the whole environment sweeter.

Regarding the techniques observed, leaving behind the practices of planting or maintaining trees in organisms, it was explored the terrain of forms of use of trees and forests within organisms. It was learned that within the organisms, in 85% of cases, there is the presence and management of spontaneous vegetation, demonstrating a tendency of the farmers in evidence, to adapt and produce their productive "choices" in harmony with native and local vegetation that arise spontaneously, through natural regeneration, within organisms.

The practice of orchards was observed in 50% of the participants, being, therefore, the second form of use of trees that were most mentioned being conditioned to market issues. Forms of use such as wind bars and ecological corridors were seized in 42% of the organisms. The practice of bar wind was identified as important in several ways among them are protected from pesticides, thermal protection of crops and the entire organism, and also for conferring greater astrality on agricultural individuality.

Animal welfare, based on Voisin Rational Shepherding (PRV) techniques, was found to be a common concern for those who work with animal husbandry, even if this was not their main productive "choice". In this sense, the introduction of trees in the grazing areas serves to provide thermal comfort to the herd. The use of trees to demarcate and support contour curves was verified in 29% of the organisms, not being an intrinsic practice of this community, but is remarkably present in organisms, considering that this practice is not considered as common in the practice of industrial agriculture.

Through the interviews, it was possible to apprehend that the practice of Agroforestry Systems (SAFs) would be limited to 29% of the interviewees, which would validate the idea that the use of SAFs should not be considered as usual for this community. However, following Franco's concept of SAFs (2015, p. 5, 'our translation'), "[...] a form of land use that combines the production of crops and/or animals, with forest species, simultaneously or in sequence, in the same area." it is understood that even though the interviewed agents do not consider that they practice SAFs when presenting ways of using trees such as wind bars or even contour lines, these agents are experiencing more or less complex agroforestry systems. It is believed that the practice of SAFs can be further strengthened within the community in evidence since the SAFs constitute a growing practice within the experiences of ecological agriculture in Brazil.
In this sense, it is understood that this community and Biodynamic Agriculture have a great potential to build an agroforestry agricultural reality, a finding that led to questioning agents

about what they seized about Biodynamic Agriculture and Agroforestry. The set of responses obtained evidenced the strengths and existence in the relationship between Biodynamic Agriculture and Agroforestry and also demonstrate the general perception of the community in evidence regarding this form of forest use. Among the weaknesses, the difficulties inherent in the production of vegetables, the productive choices, and, therefore, the acceptance of the construction of markets stand out. Among the facilities, 100% of agents understand that SAF's can be a fundamental strategy for agriculture.

As much as the focus of this work is to list the contributions referring to trees and forests, the human being as a mediator and creator of life is, yes, extremely important for the debate to which one wishes to contribute. Because agriculture is made by humans, it was developed by humans, and even where machines are the biggest highlights and agricultural innovations, for now, there is always the human hand as the instituter of the action. Therefore, any debate on Sustainable Development, Ecological and Agroecological Agriculture, etc., any proposal for change that does not consider human beings, will be doomed to failure. The internal shift in the structures of human thought must necessarily take place for sustainability to reverberate.

The agents participating in this research were asked about the changes that Biodynamic Agriculture brought to their lives. These responses were categorized and can be seen in Table 2.

Table 2 - Perceptions of agents in evidence regarding the changes brought by Biodynamic Agriculture to their lives.

Analysis Categories	**Response frequency**
Seek knowledge	16
New look at the environment	15
Expansion of life perception	14
Leave the conventional structures	14
Seeks a harmonious coexistence with the	13
Critical thinking	12
See Beyond the Material	11
Spirituality	9
Anthroposophical Worldview	7
Loving conscience	4

Source: The author

It was possible to apprehend that all agents demonstrated that yes, the practice of Biodynamic Agriculture contributed in some aspect to the development of their awareness of reality. Be linked to ecological, social, spiritual, personal, etc., issues. All these aspects have already been cross-sectionally presented in this study, as they are intrinsic in the thought structures of these agents, which crystallized in the results presented here. However, some statements became so

important, for reinforcing this transforming character of human consciousness arising from Biodynamic Agriculture, where biodynamic food heals and strengthens the physical so that it is a healthy envelope of a thinking, critical being, integrated with Nature and endowed with a philosophy of freedom, which made it necessary to present them:

"If you look at human conditions today, they're all of the warnings, they're all of the fear, you go out on the street and you have to be afraid of the other, it's like animal logic, but very bad, unnatural. And we, when we give ourselves the category of human being, can also transcend ourselves socially, ecologically, going beyond ourselves and also spiritually. In the vertical direction. It is possible to integrate ourselves in this evolutionary process that goes beyond what is around us. It's transcendence. And for me to feel able to do that, I need real food."

"Biodynamics, for those who have already grown up as a farmer... like this... it changes your perception of what agriculture is... How you can work... right? And improve... right? And it do you look for the environment! And in total, well, we see an effect... Not only in terms of saving on compost, as I've already said... Because we, as people like the family group who work there, have changed a lot. ... In the view of how to see agriculture, right? Between each other, in the relationship with nature... It completely changed our vision, right? About agriculture... We study a lot about this, right, about the organism of Biodynamic Agriculture... About how much nutrients are absorbed, what the body absorbs better, the digestive part is better... I see that each time I'm learning more... This relationship with the whole, right? We are part of Nature. We have to know how to take advantage of what it provides us with food, we are part of this environment that we have to conserve... We are part of a whole, right? I think the big thing is this, right. We learn a lot from our relationship with nature, right? Because agriculture is not just about exploiting the land. Not! We have to give our share! Because nature is certainly very generous. That's it'

Finally, it is reaffirmed here that it is the set of practices, customs, and meanings that shape Biodynamic Agriculture as a Brazilian reality of a sui generis character, which presents its productive structure linked to ecological balance, endowed with meaning and method, thus demonstrating, the importance of the Non-Geographic Community of Agents of Biodynamic Agriculture in Brazil for a deepening of the debate on Sustainable Rural Development, mainly due to its importance for the construction of a society structured in harmony with Nature.

The cosmovision of agents of Biodynamic Agriculture in Brazil, although not exempt from the influence of mechanistic thoughts, is still an important object of study to capture greater and even deeper contributions on aspects that should be thought about relationship between human beings and Nature and the future of life on earth.

FINAL CONSIDERATIONS

It is believed that the objective sought with this article has been fulfilled. It was apprehended that the look of the agents in evidence did not allow looking at the individual tree without thinking about the soil, weather conditions, fauna, etc., demonstrating a thought structure that communicates with Steiner's holistic perception. In this sense, the importance of the arboreal organism lies in its socialization, not necessarily material, with other aspects and factors, making trees important beings in the composition of dynamics and landscapes, making it possible to understand that their presence influences the energy conditions of agricultural organisms, contributing to their individuality, astrality, and quality of life.
It was apprehended that there is in the relationship human/trees, or human/forest, a path to reencounter the essence of the extinct, the suprasensible, the look beyond the physical, the paths of love, hope, work on the land to in addition to the production of products with economic

purpose. In the rapprochement of human beings with forests, a process of overcoming the mechanization of life is engendered. It was observed that Biodynamic Farmers have an impulse to weave a harmonious relationship with trees and forests and that these relationships are no longer enhanced due to issues of economic sustainability.

Biodynamic farmers often need to fit into pre-established market logistics, and this need hampers farmers' greater attention to trees, which are left to the background. Thus, economic and market configurations and logic were also perceived as key elements for the dissociation of human beings from nature. In this sense, the importance of consumers as market-building agents that can enhance the construction of agricultural realities increasingly harmonized with nature is highlighted.

The community in evidence is also a producer of so-called ecosystem services. So here, it is understood that as the community that produces these services, and as their productive "choices" are often deliberated by the bias of economic sustainability, a solution that enhances the emancipation of the Agents in evidence lies in the correct valuation of the provision of these ecosystem services concerning market demands, making it possible for the agents' productive "choices" to depart increasingly from the knowledge learned through their daily relationship with nature, thus having ecological balance as a guiding factor for productive "choices".

Also, it was learned that Biodynamic Agriculture, in general, is permeated with deep and solid subjectivities. In learning, doing, or being a biodynamic farmer, there is also an action focus on human thought, on ideas. Steiner's lectures did not focus on agricultural practices. The reality of this community attaches importance to the structure of thought of individuals, or else the development of the thought of individuals. Thus, it is apprehended in this research that it is through deconstructed and reconstructed thinking, through a holistic view of life, such as Steiner had, that individuals will start to modify their agricultural practices and these new practices, in turn, will crystallize into foods and environments with different characteristics.

Finally, the theoretical and empirical reality of biodynamic agriculture in Brazil supports a cosmovision about trees and forests that has much to contribute to the improvement of understanding about sustainable rural development, presenting important experiences as references for the theme and future projects and planning development strategies that will determine the future course of life on Earth and assist in solving the problems arising from the current climate crisis.

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Opportunistic agroecological adaptation by farm women under semi-arid conditions of Rajasthan, India

Dr. Dheeraj Singh[1]

[1]Central Arid zone research institute, Krishi Vigyan Kendra, dheerajthakurala@yahoo.com

ABSTRACT

Climatic vulnerability and exposure to multiple stressors have compelled small-holder farmer world over to develop location specific knowledge and adaptation strategies to sustain their livelihoods in risk-prone ecosystems. Under these conditions Madhu Devi a local female farmer of Pali district utilized agroecological knowledge to convert stress into opportunity with autonomous adaptation. The major stress in this area is high temperature, hot and dry winds, low and delayed monsoon, high salinity in ground water, erratic rainfall and early recession of rains. The farmer is having her land at scattered sites in Hemawas dam which is used to store runoff water in catchment area of around 260 hectares of land. The farmer very effectively utilizes the conserved soil moisture in Hemawas dam catchments area for crop diversification under varying moisture regimes. The stress of climate variability and salinity in varying landscape traditionally used for cultivation of wheat, barley, chickpea and mustard with low yield, has now been substituted with muskmelon as opportunistic adaptation. The terminal heat and aberration of temperature during February-March negatively impact yield of *winter* season crops. This variability is now adapted with introduction of muskmelon a fruit vegetable relished for its taste and sweetness. In the land, freed from water, she grows muskmelon in the conserved moisture during last week of February. Sowing is done by simply ploughing the land to open up the soil in the open spaces using local seeds specially treated with luke warm water and kept in moist jute bags overnight for easy germination. This adaptation is continued when there is very minimal competition with other agricultural enterprises and related. The farmer planks the field when the seeds germinate and attain 2-3 weeks age to trap the moisture and level the field (Patil et al., 2014). This also controls the insects attacking the crop by burying the eggs deep and sealing the soil. The seeds germinate and utilize the runoff organic matter and conserved moisture for luxurious growth and high yield. Easy market through organized muskmelon's contractors at field itself makes this adaptation further robust for the farmers' livelihoods. This location specific agroecological adaptation further empowers other rural women, who are landless and relatively more marginalized. This adaptation provides an insight for the formal science about how formal and informal knowledge can be hybridized to co-produce more robust adaptation to convert stressors into opportunity.

INTRODUCTION

The arid western part of Rajasthan state (211867 km^2), encompassing a major part of the Thar or the Great Indian Sand Desert, is dominated by sand dunes, sandy plains of variable thickness (some being salt-affected), as well as some barren hills, uplands and gravelly pavements. Mean annual rainfall in the region varies from about 500 mm along the slope of the Aravallis in the east to 100 mm along the border with Pakistan in the west, more than 85% of which is received during the period of SW monsoon (June-September). High summer temperature (often reaching 50°C) and very low winter temperature (sometimes below 0°C), with large diurnal and spatial variability, as well as high wind speed between March and July with speed gusts of >50 km/h during dust storms, are the other major climatic characteristics. The mean annual potential evapo-transpiration exceeds precipitation by a wide margin (1400-2000 mm). Between 1801 and 2002, this area suffered from 42 serious droughts that reduced agricultural production. In

early 2013, parts of western India were suffering from the worst drought in more than 40 years. The area is dominated by small-scale farmers, especially poor subsistence farmers which loath to take risks, they cannot afford to. If a gamble does not pay off and in the context of uncertain physical and financial climates, investing in improved seeds, fertilizers and other inputs is a gamble. The farmers and their livestock in arid zone are always at risk. In this circumstances farmer of this area generally perform farm activities which are time and labour intensive, monotonous and more drudgery prone. Therefore, a paradigm shift in farming practices through eliminating unsustainable parts of conventional agriculture (ploughing/tilling the soil, removing all organic material, monoculture) is crucial for future productivity gains while sustaining the natural resources.

The high biotic pressure on the arid lands aggravates the desertification process and reduces the productivity of crops, which results in over-exploitation of resources of the region (Gupta and Narain, 2003). The per capita availability of land is consequently decreasing; while food and fodder demand is increasing. Sustainable crop production is thus a major concern to meet the food and fodder requirement under such circumstance. Conservation agriculture, a concept evolved as a response to concerns of sustainability of agriculture globally, has steadily increased worldwide to cover about ~8% of the world arable land (124.8 M ha) (FAO, 2012). Soil moisture conservation is a resource-saving agricultural production system that aims to achieve production intensification and high yields while enhancing the natural resource base through compliance with three interrelated principles, along with other good production practices of plant nutrition and pest management (Abrol and Sangar, 2006). Crop failure is a common feature either due to inadequacy of rainfall or due to shortage of soil moisture to meet the crop water requirements during different phenophases. Besides this, the arid region has several biotic and abiotic limitations that are responsible for low productivity. Under these conditions a local female farmer (Madhu Devi) of Pali district Rajasthan (India) utilized agroecological knowledge to convert stress into opportunity with autonomous adaptation. The farmer is having her land at scattered site in Hemawas dam which is used to store runoff water in catchment area of around 260 hectares of land. The farmer very effectively utilized the conserved soil moisture in Hemawas dam catchments area for cultivation of muskmelon rather than traditional crop like wheat, barley, mustard and chickpea which have low yield and less return. The objective of this paper is to review the salient results of soil moisture (in-situ) conservation technologies for increased land productivity and improve livelihood security in the western arid region of Rajasthan (India).

MATERIAL AND METHOD

Site details: - The present study was conducted in Hemawas dam catchments area, which is located on (25.7012^0 North latitude and 73.3370^0 East longitudes) the Bandi river of Pali district which falls in the arid zone of western Rajasthan (India). The area had sub-mountainous and has undulated plains with scattered hills here and there. The climatic conditions near Hemawas area are marginally different from the typical arid western Rajasthan. Although, basically the summer season raises the temperature to 46 - 47 °C during peak (May-June) months, a large variation in temperature is found due to adjoining green and hilly areas. Winters are moderately cool during December-January when the mercury dips to 4 - 5 °C range. Monsoon brings respite from long drawn summers and the rains during the months of July-October result into average rainfall of 450.7 mm in the district. During the monsoon period relative humidity is high varies from 60% to 80%. The summer months are driest when humidity varies from 20% to 30%. The area produces traditional crops like bajra, guar, sesame and pulses in the kharif season. In the rabi season wheat, barley, mustard and vegetables are the dominant crops. The soils are yellowish brown with sandy loam to sandy clay texture; it is suitable for cultivation but low rainfall and high evaporation. In this area crop failure is a common feature either due to inadequacy of rainfall or due to shortage of soil moisture to meet the crop water requirements

during different phenol phases. Besides this, the arid region has several biotic and abiotic limitations that are responsible for low productivity (Faroda *et.al.,* 2007).

Figure 1: Effect of conserve moisture and irrigated conditions with input levels on growth and yield parameters of muskmelon

Management practices followed: During rains the dam becomes its full capacity and it is not possible to take any crop. Gradually after the rains the water level in the pond declines very fast due to seepage loss and utilization of water by the farmers to raise winter season crops. By the month of October ending a big proportion of pond land at higher level is available for raising rabi crops due to subsequent drying of water in the pond and only the deeper part of pond retains water. The farmers of this area utilize the available water for irrigating the crops as the result, more and more area becomes available for cultivation due to utilization of water stored in the deeper parts of pond. When the water in dam is dry or near to empty many farmers utilizes the available or conserved moisture for raising different crops and vegetables. Under these conditions a local farm woman named Madhu Devi utilizes agroecological knowledge to convert stress into opportunity with autonomous adaptation by cultivation of short duration crop muskmelon. In her adaptation the field is first ploughed two times to break hard pan, big soil clods and making proper soil tilth. Proper soil tillage is a prerequisite for good crop stand, growth and yield. Excessive tillage, particularly in light textured soils, disintegrates clods and exposes soil to wind and water erosion. Reduced tillage implies economy in time, labour and energy besides reduced soil moisture losses, maintenance of soil structure and increased cropping intensity (Saxena *et al.*, 1997). The indigenous variety (KAJRI) seed of musk melon is used for sowing after seed treatment. The farmer made pit hole of 4-6 cm size at a distance of 6 feet row to row and 1-1.25 feet plant to plant. In each pit 4-6 treated seeds are sown and covered by sand. After 5- 6 days when the seeds geminate, the farmer covers the seedlings in early stage by local available plants namely C*rotalaria burhia* and *Leptadenia pyrotechnica* for moisture conservation and checking the loss of evaporation. The seeds germinate fast and utilize the runoff organic matter and conserved moisture for luxurious growth and high yield When plant attains 10-15 cm a light ploughing of soil is done to conserve the soil moisture and controlling the sucking insects by burying the eggs deep and sealing the soil. After this operation the pants attain luxuriant growth and row plant overlap each other conserving moisture which is sufficient for its full growth and development till the maturity. Thus, this in-

situ moisture conservation practice or location specific agroecological adaptations not only conserve moisture but also maintain soil fertility. In this paper traditional practice of muskmelon using conserved moisture have been compared with the muskmelon cultivation utilizing all inputs with proper irrigation facilities.

RESULT AND DISCUSSION

Agronomic management	Length of vine (cm)	No. of leav	Days to first flowering	Days to first Female	Days to first harvest
Conserved moisture with low	190.9	70.6	28.7	32.3	82.0
Adequate Irrigation with high	214.0	82.3	34.0	39.5	89.0
Agronomic management	**No. of fruits/ vine**	**Frui t weig**	**Fruit yield / vine (kg)**	**Fruit yield (q/ha) 16666**	
Conserved moisture with low	10.5	330	3.47	442.0	
Adequate Irrigation with high	12.7	378	4.78	578.0	

The study results revealed that irrigation management practices with inputs influenced the growth parameters mainly flowering behavior, yield parameters and yield of muskmelon (Table 1). Application of adequate irrigation with high inputs like intensive tillage, fertilizers, plant protection measures etc. contributed to higher growth parameters of muskmelon crops viz., average length of vine (214.0) and number of leaves/plant (82.3) with an increase of 12.1 and 16.6 % as compared to crops sown under conserved soil moisture condition with lower amount of inputs. A delay was observed with regard to days to first flowering (34.0), days to first female flowering (39.5) and days to first harvest (89) for the crops subjected to irrigation water as compared with the crop under conserved soil moisture condition. Thus, crop sown under conserved soil moisture condition with lower amount of inputs were early with regard to flowering (28.7) and also produced early marketable fruits (82 days). The increase in growth parameters, delayed flowering and fruiting was attributed to regular sufficient supply of soil moisture and inputs under irrigated conditions. The adequate and timely supply of irrigation, nutrition, weed and insect pest management lead to improve availability of nutrient that enhanced proper growth and development of plants. Minimizing the competition of crops with weeds by timely weeding also resulted in higher growth parameters of plant, as compared to conserved moisture crops with low inputs. These findings are in close conformity with the findings of Anbumani *et. al.,* (2017), Al-Majali and Kasrawi (1995) in muskmelon and Ban *et. al.,* (2004) in watermelon crops.

The results also revealed that the adequate irrigation supply coupled with high inputs increased the growth parameters of muskmelon and also increase number of fruits/vine (12.7), fruit weight (378 g) and fruit yield/ plant (4.78 kg) as compared to conserved soil moisture crops with low inputs. It was due to availability of sufficient soil moisture with higher uptake of nutrients to the crop throughout the growth duration for better growth and development of fruits. These results are validating with the Anbumani *et. al.,* (2017) in muskmelon, Johnson *et. al.,* (2000),

Ansary and Roy (2005) in watermelon and Rani *et. al.,* (2012) in pointed gourd. The results indicate that fruits yield of muskmelon recorded higher with adequate irrigation with high inputs (578 q/ha) as compared to conserved soil moisture practices with lower inputs (442 q/ ha) and increased by 30.8 % higher as compared to conserved moisture practices. The higher number of fruits/plant and fruit weight was due to combined availability of soil moisture with proper nutrition throughout the muskmelon growth period. The above results are close conformity with the Anbumani *et. al.,* (2017), Johnson *et. al.,* (2000), Ansary and Roy (2005) in watermelon, Arancibia and Motsenbocker (2008) and Rani *et. al.,* (2012) in pointed gourd.

Table 2: Effect of conserve moisture and irrigated conditions with input levels on profitability of muskmelon

Agronomic management practices	Cost of cultivation (Rs/ha)	Gross returns (Rs/ha)	Net returns (Rs/ha)	B:C ratio	Productivity /days (Kg/ha)	Net returns /day (Rs/ ha)
Conserved moisture with low	122500	309400	206900	3.02	552.5	2586
Adequate Irrigation with high	176850	404600	247750	2.58	608.4	2608

The irrigation management practices with agronomic inputs level were influenced the profitability of muskmelon crops (Table 2). The adequate irrigation application combined with high production inputs increased the cost of production (Rs. 1,76,850/ha) that recorded the higher gross returns (Rs. 4,04,600/ha) and net returns (Rs. 2,47,750/ha) compared to the conserved soil moisture practices with low inputs-based muskmelon cultivation. Also, similar trends were observed in the productivity/day and net returns/day but the difference was non-significant. Benefit cost ratio highest were recorded with conserved soil moisture practices with low inputs (3.02) as compared to adequate irrigation with high inputs management practices (2.58). Thus, the above results clearly reveal that muskmelon cultivation under stress conditions in this area is very profitable due to soil moisture conservation practices and hot and dry humid conditions with low temperature in night is favorable for its sweetness and its quality attributes. The market prefers the muskmelons grown under conserved moisture conditions and they are paid premium prices for their crop. Irrigation practices often aims at total replacement of culture evapotranspiration in order to obtain maximum yield. In many occasions experiments demonstrate that is possible to reduce water use without significant losses in yield. In addition, the increases in health/quality related compounds and postharvest preservation are evident in response to environmental stress. The use of regulated stress (water stress, salinity, heat) is a feasibly strategy to enhance accumulation of health promoting compounds in food. Another interesting perspective is the improvement of plant resistance against biotic stresses (e.g., pests and diseases) when submitted to controlled abiotic stresses, as was scientifically demonstrated in experiments utilizing different fruit and vegetable crops (Nora *et. al.,* 2012).

Easy market through organized muskmelon's contractors at field itself makes this adaptation further robust for the farmers' livelihoods. This location specific agroecological adaptation further empowers other rural women, who are landless and relatively more marginalized. They are the main actors in the entire operations of the muskmelon's cultivation where either they contribute as family labour or as daily paid laborer earning cash from land owners. This adaptation provides an insight for the formal science about how formal and informal knowledge can be hybridized to co-produce more robust adaptation to convert stressors into opportunity.

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Organiser
Section for Agriculture
at the Goetheanum Hügelweg 59 CH-4143 Dornach
Tel. +41 61 706 42 12 agriculture@goetheanum.ch
www.sektion-landwirtschaft.org