Agricultura 6: 1-4 (2008)

Biodynamic agriculture from past to present

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Biodynamic (BD) agriculture substantially influenced the development of organic agricultural systems in the past - from the core idea of a farm as an organism to the nutrient and energy cycling principles that are innate to modern organic farming today. Presently areas of environmental issues, energy use, chronobiological research, landscape development and quality assurance are in the forefront of BD research efforts across the world. For some of the areas promising preliminary results point towards a successfull transfer into practical farming in the near future, helping to create sustainable and holistic natural, social and economic systems.

Key words: biodynamic agriculture, environment, lunar cycle, landscape management, quality

INTRODUCTION

Biodynamic (BD) agriculture, as one of the organic agricultural farming methods, was proposed by Steiner (1924) in a series of lectures named the „Agricultural course“ and the BD farming method is striving for diversified, resilient and ever-evolving farms, which could provide ecological, economical and physical long-term sustainability for mankind. It encompasses practices of composting, mixed farming systems with use of animal manures, crop rotations, care for animal welfare, looking at the farm as an organism/entity (nutrient cycling) and local distribution systems (Reganold 1995), all of which contribute towards the protection of the environment, safeguard biodiversity and improve livelihoods of farmers. Nowadays, there are around 3,500 BD farms in 40 countries, whose area of more than 124,000 ha is certified according to Demeter standards (Demeter 2008). The BD method emphasizes a holistic approach towards farming and became the subject of research efforts during the last decades. Despite these efforts there are still many future research perspectives on BD agriculture in connection with the wider circle of scientific disciplines. How does BD agriculture perform environmentally? What about energy use? Is there any benefit to landscape design? Can BD agriculture contribute towards more sustainable food systems (from production to consumption)? These are just some questions arising when trying to get a deeper view into BD agriculture.

ENVIRONMENTAL PERFORMANCE

Soil organic matter (SOM) is an important indicator of the organically bound carbon (Corg) pool in soils. Increasing the amount of C stored in vegetation and soil (also called C sequestration) is a preventative measure towards slowing CO_2 buildup in the atmosphere (Janzen 2004) and thus slowing climate change. Corg was maintained at the same level for over 21 years and even showed a small gain in the BD system at the DOK trial in Switzerland, whereas the other farming systems investigated all had a net loss of Corg (Fließbach et al. 2007). Similarly, in another trial SOM was maintained at the same level only in the BD, whereas it declined in the farmyard manure and minerally fertilized treatments (Raupp 2001). Farm-scale comparisons also show differences between conventional and BD farms, where long-term BD cultivation results in higher SOM levels (Reganold et al. 1993; Droogers and Bouma 1996). Next to CO_2 and methane (CH_4), also N (in the form of nitrous oxide or N_2O) plays an important role in greenhouse gas (GHG) emissions from agricultural land-use (Janzen 2006). With the rising use of supplemental N added to soils in the form of mineral fertilizers and animal manures, also N_2O emissions increase and might become a more urgent issue in tackling GHG emissions from agriculture than C (in the form of CO_2) is today (Janzen 2006). When we look at the DOK trial, the ratio between yield levels and N applied turns out highest in the BD and ORG systems, when compared to the conventional and minerally fertilized systems and ranges from 2:1, 2:1, 1:1 to 1:1,2, respectively (Mäder et al. 2002). Moreover, the BD system was proved to perform best regarding the levels of total soil N when compared to the other systems, where great amounts of N were denitrified into the atmosphere, but were retained in the BD system in the form of soil organic matter and soil microbial biomass (Fließbach et al. 2007).

However, research done up-to-date is limited to few published articles, therefore additional trials in different climates with additional crops, varieties and genotypes are needed. Nevertheless, environmental influences of agricultural production systems will become an ever increasing issue in the face of environmental degradation, habitat pollution, soil fertility and sustainability.

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ENERGY USE AND EFFICIENCY

In addition, rising energy prices will eventually intensify interest in the search for farming systems alternatives, where energy efficiency would consistently increase and consequently energy consumption per unit will be lower (Pimentel 2006). However, interest is already present, as long-term studies and farm comparisons have been done comparing energy efficiency of different farming systems. Results show better performance of organic systems, where one study also includes the BD system. Yields are lower in the BD system, when compared to the convetional system, but so is the energy consumption up to 50% lower mainly due to non-use of external production factors, like mineral fertilizers and pesticides (Mäder et al. 2002). This leads to a more energy efficient production in the BD system (20-56% better than the conventional system), in terms of energy consumption per crop unit of dry matter and energy consumption per unit of land area (Mäder et al. 2002). Less fossil energy used results in less carbon dioxide being emitted to the atmosphere and thus has a direct effect on global climate change mitigation (Janzen 2004). In connection with energy use and climate change a model called „Sustainable Process Index" or SPI, developed by the Technical University Graz, would be of great value in order to compare the ecological footprint a certain production system leaves on planet Earth. Controlled field comparison trials with detailed data records should be one reliable source of information to use in the model. But also on-farm data gathering and later interpretation and comparison through the model would further clarify the role of BD agriculture in this ever-evolving energy and climate change debate.

CHRONOBIOLOGICAL RESEARCH

Steiner (1924) mentioned positive effects of a full moon in an agricultural context. On this basis Spiess (1990a and 1990b) scientifically researched the effects of lunar rhythms and proved the influence of several rhythms on growth, yield and quality of little radish and rye. His results, however, were contrasting to findings of Thun (1994), who found one single rhythm to be the most important one. On the basis of a reanalysis of Spiess' data, Kollerstrom and Staudenmaier (2001) argue that Spiess' experimental results to comply with the findings and recommendations of Thun, therefore confirming a lunar influence on crop growth and development. However, the influence of other astrological bodies (i.e. planets) on crop growth and development is difficult to research and therefore also difficult to reject or prove an influence. One cannot say to live without a certain planet for a year and then see the influence this planet had on crop growth and development. And with our current knowledge it is also impossible to shield areas of planet Earth from just certain, not all, influences planets have. Therefore one would have to come up with an innovative and at the same time trustworthy idea to be able to conduct research in this highly interesting area.

LANDSCAPE DEVELOPMENT IN RELATION TO BIODYNAMICS

The idea of a farm organism or farm individuality is one of the core principles of BD agriculture (Steiner 1924). This principle was also taken up by Lord Northbourne, the father of modern organic agriculture in England, when he coined the term „organic" agriculture – refering to the „farm as an organism" point of view he got from the teachings of Steiner (Conford 2001). Usually it indicates that farm management should minimise nutrient and energy inputs in order to make the farm self-supporting and autonomous (Vereijken et al. 1997). But it also encompasses a broader idea of the farm placement in its surroundings, the involvement of the people working on the farm, a balance between the sub-systems or "organs" of the farm (arable crops, pastures, livestock, horticulture, ...) and the elements of nature, such as forests, heaths, moors and watercourses (Vereijken et al. 1997). In addition, Ho and Ulanowicz (2005) provide arguments for an organisms point of view upon sustainable systems, based on thermodynamics. If we extend this point of view to a greater scale, a farm also plays an important role in landscape design and development. For this reason, a bottom-up, present situation improvement approach towards landscape design on farms has been developed, where it is aimed to develop nature-compliant agricultural systems, starting with the acceptance of the natural conditions and developing them according to the needs of the society (Beismann 1997; Vereijken et al. 1997). The Goethean-phenomenological approach has, next to conventional methods and solutions, an integral part in this method of landscape assessment, design and development (Colquhoun 1997). In conjunction with the above mentioned methods this bottom-up approach resembles participatory action research (AR), where researchers are not merely observers of the system, but actively take part in the process of shaping it (Greenwood et al. 1993). Moreover, it is argued that sustainable and ecologically sound management of the landscape cannot be achieved only by top-down planning and regulations, but rather with bottom-up, individual and participatory landscape development (Beismann 1997). Indeed, solutions to problems of one farm do not necessarily solve the same type of problem on another farm and tailor-made solutions should be applied, where demanded (Vereijken et al. 1997). Encompassing a broader set of goals than just landscape design, Helmfried et al. (2008) used AR methods to research and shape local, sustainable and environmentally friendly food systems. Linking both approaches with a goal of improving agricultural and natural systems is a promising future perspective, where multifunctional, vibrant, independent, diverse and sustainable agricultural systems would provide quality of food and lifestyles and above all also security in the widest sense possible.

FOOD QUALITY

Bio-crystallization and the capillary dynomalysis (or Steigbild) method are two so called picture forming or holistic methods to asses food quality and origin. The methods have been developed from the viewpoint that living organisms do not just exist as substances, but have structuring and organizing properties. These properties control the form and function of an organism (Meelursarn 2006). These methods have been up-to-date validated and tested on several samples originating from controlled field system comparisons (Kahl 2006). In addition, a Triangle network of laboratories dealing with biocrystallization strives to develop uniform ISO standards for the evaluation of biocrystallograms and dynomalysis pictures (Andersen et al. 2003). With the use of these methods, however, one is able to discriminate only products originating from known origin and thus create reference lines. Plants grown in different climatic and environmental conditions express different qualitative parameters and therefore one is unable to make direct comparisons and conclusive statements on the quality of such plants. Promising results from renowned institutions and an increasing number of dissertations could spur interest and acceptance of picture forming quality determination methods. Furthermore, research should not only focus on the existent methods, but also strive to discover new, efficient, fast and affordable methods for holistic food quality determination.

CONCLUSION

When Rudolf Steiner held the Agricultural course in 1924, many of his ideas and impulses sounded far-fetched and illusionary. Some of them still do. However, most of the ideas given were successfully transfered into practice and contributed towards the development of modern organic agriculture (Conford 2001). Additionally, when science makes progress in discovering the interconnectedness of the many Earths systems and the complexity of nature, many of the statements can be viewed upon from a different viewpoint. For example, Steiner suggested that "...if you work the soil as just explained, then the plant will be ready to attract "things" in its wider surroundings. The plant can take benefit not just from the contents of the field, where it grows, but also of the contents of the soil in the neighbouring pasture, if the plant needs it. The plant can also benefit from the soil in the neighbouring forest, if it is made sensible in the described way..." (Steiner 1924, p.160). And indeed, with todays knowledge on the existence of extensive mycelial networks in soils, which have been proved to connect individual species, genera, and even families of plants (He et al. 2003), in connection with results indicating the improvement of arbuscular mycorhizzal fungi by BD preparations (Mäder 2002), we can confirm the statement given almost 100 years ago. With the progress and advancement of interdisciplinary knowledge we will eventually be able to understand many more of the provided food for thought and develop myriad of new scientific approaches, methods and come to a more conclusive insight into the world, that surrounds us.

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Received: July 7, 2008
Accepted in final form: September 11, 2008