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Quantum-Based Agriculture: the Final Frontier?

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Abstract

Organic farming already meets multiple sustainability goals, and factors limiting its mainstreaming are social rather than technical. What is the next step for organic farming? To date, both organic and industrial agriculture have been based on the particle-matter approach within the disciplines of chemistry and biology. This review paper argues that the logical next step is to embrace Quantum-Based Agriculture (QBA) that draws from the theories and concepts of quantum physics and biology and takes a wave-based approach. The paper outlines how modern medicine, and many of our communication technologies, already apply quantum science, it explains the nature of QBA, its potential, and how commercial agricultural projects in the EU are already integrating quantum theories. Finally the paper notes that QBA is not new; it also may explain the mechanisms by which indigenous and Biodynamic farming practices work.

Introduction

Organic farming, done well, already meets multiple sustainability goals, and factors limiting its mainstreaming are arguably social rather than technical. So whilst on the one hand, IFOAM's Organic 3.0 rightly attempts to take organic to the mainstream, let us not forget – nor lose - the pioneering nature of the organic movement. What is the next step for organic farming, to boldly go where few people have gone before? To date, both organic and industrial agriculture have been based on the particle-matter approach within the disciplines of chemistry and biology. This approach focuses on the nature of individual components of physical systems, be they atoms, plant genes, soil-borne diseases or water pollutants. In contrast, Quantum-Based Agriculture (QBA) draws from the theories and concepts of quantum physics and biology that take a particle-wave-based approach. Only features of biodynamic agriculture, along with more indigenous farming approaches, could claim to be synonymous with QBA.

Rationale

Recent years have seen an unprecedented increase in knowledge and understanding of quantum theories. Quantum theory (aka quantum physics or quantum mechanics) is one of the two main branches of modern physics. While general relativity provides a picture of the macro (space-time and gravity), quantum theory addresses the micro, including subatomic particles. Today, quantum theory is used in a huge variety of applications in everyday life, including lasers, CDs, fibre-optics, digital cameras, bar-code readers, fluorescent lights, computer screens, transistors, super-conductors, spectroscopy, MRI scanners, and so on.

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Most recently, 2014 saw the publication of the first book on quantum biology, which concerns the applications of quantum mechanics and theoretical chemistry to biological objects and problems (Al-Khalili and McFadden, 2014). However, the integration of quantum principles in agricultural science has, to date, been negligible. Yet one practitioner-based farming book (Lovel, 2015) suggests that the application of quantum principles in farming techniques increases input efficiency and animal welfare, while reducing the negative environmental side-effects of farming. This situation suggests that any positive developments in this area hold high potential for an early impact, and the urgent challenge for research is to deal with a growing set of questions for farm practice about emerging new technologies based on wave-principles and information techniques.

Results

Review of the literature

Aside from the seminal and inspirational work of Peter Tomkins and Christopher Bird in the 1980s (the Secret Life of Plants, and The Secrets of the Soil, both 1989), and some early articles in the journal Biological Agriculture and Horticulture[4], research into QBA has been relatively sparse, and much of what exists has been undertaken in Soviet countries that has not yet been accessed or translated. Some research has been undertaken on the general relationship between quantum theory and agriculture, including wavelengths and agriculture (Callahan, 1994), effects of sound in agriculture (Doorne, 2002), crop sciences and quantum theory (Fernandez, 2009), quantum physics and biology (Cannenpasse-Riffard, 2011) and photons in biology (van Wijk, 2014). In terms of crop and livestock health, studies have looked at the response of bacterial cells to sound (Matsuhashi *et al.*, 1988), the relationship between infrared light and insect control (Callahan, 2001), effects of magnetised water on pot plants (Kamminga, 2004), and the effects of electromagnetic stimuli on livestock and fish (Cuppen *et al.*, 2007). Studies on food nutritional quality have focused on the nutritional quality of apples (Bloksma *et al.*, 2001), general nutrition and soil health (Sait, 2003), and the energetic quality of milk (Woestenburg *et al.*, 2005).Crop and livestock productivity research has looked at the effects of sound and electromagnetic frequencies on wheat (Katsenios *et al.*, 2015; Measures & Weinberger, 1970), on plants' stomata (Oliver 2002) and on dairy herds (Kieft *et al.*, 2008). In particular, a study by Souza *et al.* (2006) on the effects of magnetic treatment of tomato seeds is one of the few review papers and identifies a wide range of physiological effects in response to magnetic fields, including positive impacts on plant growth and development, enzyme activity, protein synthesis, auxin content, water uptake, seed germination, fruit ripening, crop yield and plant nutrient element composition. This paper also identifies difficulties in performing controlled experiments with reproducible results and proposes possible mechanisms behind the influence yet notes that no single hypothesis could explain these effects.

The quantum concept of entanglement offers explanation for the emerging field of research into intuitive farming, in which two of the authors of this article are involved. Intuitive farming incorporates the use of telepathic interspecies communication and/or the intuitive capacity, with cognitive abilities and experience, in making practical management decisions on farms. William J. Long first described telepathic interspecies communication in an academic context in 1919 and there have been numerous studies that provide evidence for this phenomenon since then, as reviewed by Erickson (2011).

[4] http://www.tandfonline.com/toc/tbah20/currentSee for example: Knorr D (1982) Use of a Circular Chromatographic Method for the Distinction of Collard Plants Grown under Different Fertilizing Conditions. Vol. 1 , Iss. 1
Scofield A.M (1984) Homoeopathy and its Potential Role in Agriculture—A Critical Review.Vol. 2, Iss 1
Speiss H. (1990). I. Experiments with Seeding Dates to Ascertain the Effects of Lunar Rhythms on the Growth of Winter Rye (Secale cereale, cv. Nomaro). Vol. 7 , Iss. 2

Whereas telepathy occurs when a message is received from another organism, intuition arises within the human body, particularly the heart (McCraty *et al*., 2004), arising as a 'knowing' without knowing how one knows (Erickson, 2011). As part of an ongoing study initiated by Kieft (2006), surveys and interviews with intuitive farmers who communicate directly with the animals and plants show that they report higher outputs in terms of yield, crop quality, shelf life and calf survival, while inputs such as nutritive ameliorants, irrigation, measures taken against pathogens and pests, and veterinary costs are decreased. Numerous organisations have been founded on the ability of humans to integrate their interspecies communication with everyday decisions, including Findhorn Foundation (Scotland), Tamera (Portugal), Perelandra Garden (USA), Damanhur (Italy) and Cooperative Biobalance (USA). Nuthall (2012) describes how the most successful New Zealand stock cattle farmers have developed a personalised expert system, with intuition being the primary driver, and rely less on the formal technological tools that were designed to aid their practical decision-making. According to Nuthall, the development of this ability is a practical approach for helping farmers make customised decisions for increasing efficiency. However, despite the growing body of empirical and anecdotal evidence that intuitive farming is effective in improving the production and resilience of agroecological systems, the understanding of the mechanism in terms of its scientific basis, the effects and the transfer of the skills required for intuitive farming are still in its infancy and require far more research.

The potential and current application of QBA

Overall, QBA holds the potential to address specific challenges in the agricultural sector. This is not all conjecture; a number of existing innovation and technology projects in Europe are already underway although they have not yet been fully documented. These include the use of ultrasound to control blue-green algae (funded by the EU 7th Framework Programme), the use of music based on wine protein and played to vines with beneficial effects, the disinfection of potato and onion from bacteria through ultraviolet light, the use of biophoton techniques to test product quality through shelf life of fruit, eggs and flowers, the creation of a horse health treatment center based on electromagnetism, the application of low frequency electro magnetic fields on dairy cow to lower mastitis rates, and treating water with electromagnetic frequencies.

Discussion

The need for alternative methodologies and methods

Multi- and trans-disciplinary approaches will be required to take this forward, bringing on board a range of disciplines through which quantum physics cross-cuts, including mathematics, music, ethnobotany, philosophy, psychology and sociology. Key knowledge holders of traditional and biodynamic agriculture that have affinity with the science of quantum physics and biology will need to take centre stage, such as indigenous farming cultures sharing their experiences with researchers and vice versa. For example, modern sound techniques mimic tacit knowledge in many older cultures that used sound in crop and animal husbandry. In the words of Eve Balfour, a founder of the organic movement: "*It is the unscientific mind—possessed, alas, by too many selfstyled scientists!—that instantly dismisses as superstition, magic, or even as non-existent, happenings brought about through the operation of some natural law which we do not yet understand.…We should examine again the beliefs of our forebears and study the observations on which they were based, and we should use our new scientific knowledge to interpret those observations and to sift those beliefs.*" (Pfeiffer, 1947). This in turn implies the need for development of a new set of methods that are better able to explore the phenomena involved in QBA. In fact, several of the 'fathers' of modern reductionist science, such as Boyle and Newton, also pursued alchemical study with its corresponding non-standard methods (Principe, 2011).

If we want to forge further steps along the trajectory of an authentic and expansive alternative to industrial agriculture, then this is arguably the direction of choice. Following the agroecologist Miguel Altieri's postulation that "*if the scientific basis for industrial agriculture is chemistry, then the basis for sustainable agriculture is agroecology*" (Altieri, 1995), we propose that an agriculture for the future may be based on, or at least be aided by, the science of quantum theory.

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