Organic agriculture versus genetic engineering

H. Verhoog

Louis Bolk Institute, Hoofdstraat 24, NL-3972 LA Driebergen, The Netherlands (e-mail: info@louisbolk.nl)

Received 4 December 2006; accepted 1 February 2007

Abstract

The objections of organic agriculture against genetic engineering as presented in the 2002 Position Statement of the International Federation of Organic Agriculture Movements (IFOAM) are analysed. The objections can be grouped into three categories: risks to human health and the environment, socio-ethical objections, and incompatibility with the principles of sustainable agriculture. As to threats to human health and the environment it is argued that scientists contradict each other. Socio-ethical objections indicate that farmers should also be free to choose for or against genetic engineering and therefore the free-choice criterion needs to be specified. The argument of violating the independence of the farmer depends on the present economic situation (e.g. power of multinationals) and does not seem to be a consequence of genetic engineering as such. But as genetic engineering is mainly practised by multinational organizations the argument cannot be seen separate from the economic situation. Genetic pollution is a serious issue, but only because the organic movement is against genetic engineering on principle. Once the philosophical and ethical principles behind the organic concept of sustainability are specified (the third category), almost all the objections listed in IFOAM's Position Statement can be reformulated into good reasons for rejecting genetic engineering. The basic principles are: a holistic methodological approach to living nature, the self-organization (self-regulation) of living nature, and the integrity of living organisms.

Additional keywords: integrity, naturalness, sustainability

Introduction

The International Federation of Organic Agriculture Movements (IFOAM; Anon., 2002) is against genetic engineering in agriculture, because of the unprecedented danger this presents to the entire biosphere, and the particular economic and environmental risks it poses to organic producers. IFOAM believes that genetic engineering in agriculture causes, or may cause the following negative and irreversible environmental impacts:

- Release of organisms that have never before existed in nature and that cannot be recalled.

- Pollution of the gene pool of cultivated crops, micro-organisms and animals.
- Pollution of off-farm organisms.
- Denial of free choice, both to farmers and consumers.
- Violation of farmers' fundamental property rights and endangerment of their economic independence.
- Practices that are incompatible with the principles of sustainable agriculture.
- Unacceptable threats to human health.

In view of this, IFOAM calls for a ban on genetically modified organisms (GMOs), not only in organic agriculture but also in conventional agriculture.

In their present form, I do not think that all these objections are good ones. In this paper I shall analyse these objections in an attempt to improve them. The organic movement has been rejecting genetic engineering since 1993, and this has also been accepted in official regulations. But the organic movement is dynamic and in certain areas, such as the use of modern breeding techniques like DNA marker technology or cisgenesis (Lammerts Van Bueren *et al.*, 2007), there still is difference of opinion as to its application for organic breeding purposes. So it is important to examine the reasons for opposing genetic engineering within the organic movement.

In order to analyse IFOAM's objections, I have grouped them into three categories: (1) risks to human health and the environment, (2) socio-ethical reasons, and (3) incompatibility with the principles of sustainable agriculture.

Risks to human health and the environment

According to IFOAM, genetic engineering causes or may cause 'negative and irreversible environmental impacts' and 'unacceptable threats to human health'. The irreversibility is related to the idea that GMOs have never existed in nature before and once released cannot be recalled. I find this reasoning problematic, because it has not yet been proven that the consumption of GMOs in general causes or may cause threats to human health. For instance, it is known that they 'may cause' allergic reactions. Also, in the case of environmental impacts it is generally accepted that GMOs 'may cause' negative environmental effects that go beyond the impact of pesticides. As a result, in most western countries advisory committees have been installed to prevent such negative and irreversible environmental effects. But these are scientific committees, which means that to use the negative effects as an argument against genetic engineering in general, rather than as an argument within the organic movement, opponents have to provide well-established scientific proof that negative and irreversible impacts do occur, and that they outweigh the proposed benefits of GMOs.

Therefore, using the risk argument makes the argument dependent on the state of scientific knowledge at a certain moment. As to the risks involved, at present we see that there is no consensus within the scientific community. In most cases of negative environmental impacts of GMOs other scientists have questioned the methodology used. The supporters of genetic engineering will claim that the risks will disappear in the future when more knowledge is available. But the opponents hold the view that these risks are inherent to the technology itself, because it is a reductionist technology,

not taking into account the organization of the whole organism. The analysis of the risks cannot just be left to some scientific authority. Risk perception always involves values.

The distinction between reductionism and holism can explain why in organic agriculture genetic engineering is considered to be a 'risky technology' on principle. Holism is one of the basic values of organic agriculture (Lund, 2002). The IFOAM EU Group (Anon., 2003a) states in a paper on co-existence: "We also view this technology as inherently risky, because it is based on the reductionist scientific principles that have been shown to be flawed and are increasingly discredited." A number of facts about the existing technology may substantiate this view:

- The low efficiency rate of the technology (Damm *et al.*, 1989).
- The gene constructs used are mostly synthetic constructs. The production of gene constructs is needed to obtain functionality in a new background (i.e., bacterial genes transferred to plants). Whether they work or not is tested in a trial and error process (Perlak *et al.*, 1991; Strizhov *et al.*, 1996), which counters claims of the greater accuracy of biotechnology procedures compared with traditional breeding (Haring, 2001).
- The introduction of foreign DNA leads to many unintended and unexpected effects. The uncertainty in traditional breeding, due to recombination, cannot be compared with the sometimes large effects of changing a single gene (Rist, 2000; Wirz, 2002; Filipecki & Malepszy, 2006; Latham *et al.*, 2006).
- Genetic engineering (and the risk analysis that is currently used by scientific committees) is influenced by the belief in genetic determinism, which is only part of the truth. Non-genetic, epigenetic influences during the plant's development have shown to be as important or even more important in some cases than the role of DNA. The DNA in the genome is much more dynamic than thought so far (Haring, 2001; 2003).
- Reductionistic approaches to problems in agriculture are seen as symptomatic treatments, which will only work temporarily. Evidence is the resistance of insects to the pesticides used in combination with GMOs (Weaver & Morris, 2005; Zhao *et al.*, 2005).

It is the dynamic complexity of the organism or ecosystem as a whole that leads to unpredictability and unintended effects. Genetic engineering is based on a way of thinking that is characteristic of physics and chemistry, in spite of the fact that it is usually called a 'life science'.

All these arguments, including the existing scientific controversies about the risks, are enough reason for organic agriculture to apply the precautionary principle in connection with the use of GMOs (Anon., 2003a). The stability of the gene constructs and the controllability of the technology cannot be guaranteed. In 2000, the Danish Research Centre for Organic Farming (DARCOF) mentioned the precautionary principle as one of three basic principles of organic agriculture. In short, in the organic movement this principle means that in cases of uncertainty or lack of scientific knowledge no risks should be taken. Genetic engineering is considered to be a risk-laden technology because of its unpredictability. Nature is an integrated whole and the complexity of living organisms (including ecosystems) makes that our understanding will always

be limited. The organic movement is also not convinced of its benefits to agriculture, to the environment and to mankind.

Socio-ethical reasons

According to IFOAM genetic engineering will lead to the denial of freedom of choice to farmers and consumers. Furthermore, it will endanger the property rights and economic independence of farmers in general.

Freedom of choice

Freedom of choice can be violated if genetic contamination of organic products cannot be avoided. In all regulations it is said that organic agriculture is a production method in which no GMOs are used. So it is important that genetic contamination is prevented during the entire production chain. To achieve this, it is crucial that seeds are produced that are free from GMOs. But experts more and more doubt whether this can be guaranteed (Mellon & Rissler, 2004). As contamination cannot be avoided, a threshold value of 0.9% of adventitious contamination is established in European policy. If products contain more than 0.9% GMOs they have to be labelled. Labelling is still required if the contamination is below 0.9% but avoidable and not adventitious. What we see, however, is that this threshold is regularly interpreted as a maximum, as a level up to which contamination is allowed. Research in which one calculates the minimum distance between GMO fields and non-GMO fields in order to stay below the threshold of 0.9% contamination forms an example. Such contamination is deliberately chosen and cannot be called adventitious.

Supporters of the use of GMOs have argued that if adventitious contamination with pesticides is accepted in organic agriculture, why not a small amount of GMOs in the product. This argument presupposes that there are no relevant differences between pesticides and GMOs. For the rejection of GMOs there are many more reasons beyond the risks to the environment or human health, including ethical ones, than for rejecting pesticides. The situation could perhaps be compared to someone who is a vegetarian not only because of risks to his own health but also because of ethical reasons. For this vegetarian it makes a difference when he goes to a restaurant and hears that there is less than 1% meat in the food. This person will probably refuse the food. But then, does the organic movement indeed have (and share) such ethical reasons? The word 'ethical' is not used in the IFOAM's Position Statement of 2002. This is a pity, because in its Directive 2001/18/EU the EU states that ethical criteria may be used by countries when deciding about the market introduction of GMOs. It is only very recently that IFOAM (Anon., 2005) explicitly spoke about a number of ethical principles of organic agriculture (Luttikholt, 2007).

Furthermore, it is justified that the question of free choice entails more than just the freedom to do this or that. With smoking for instance it can be argued that the freedom of the smoker should be limited because harm may be done to the health of non-smokers. If co-existence is not possible in certain cases, the growing of GMOs

harms the organic farmer (and consumers of organic products) and should therefore be prohibited. But what kind of harm is referred to? If it is not more than economic loss due to the impossibility to sell the products as organic, then some kind of liability system and economic compensation could be a possible solution. If co-existence is not possible, a more fundamental argument is that the basic right to produce (and eat) food without GMOs is violated. It is what the Swiss Ethics Committee on Non-Human Gene Technology (ECNH; Anon., 2003b) has called a 'liberty right' ('Abwehrrecht') and not a 'claim right' ('Anspruchsrecht'). The freedom to choose GMOs can be called a claim right to choose a particular production method or product. The ECNH argues that freedom of choice in connection with GM-food should be interpreted as a liberty right, meaning that "nobody should be *compelled* to consume GM products, and that the state has a duty to protect consumers from this compulsion" (Anon., 2003b). It would not be ethically justifiable to place consumers (the same applies to organic farmers) in a situation where they are forced to buy GM products. Thompson (2002) has called this 'the human right to opt out of a particular food system'. This right is violated if GMO-free food can no longer be produced, or if the food is not labelled properly.
The IFOAM argument of freedom of choice is not enough for the general claim that agriculture with GMOs should be forbidden, because this would violate the claim right of those who want to grow GMOs. A ban could only be claimed if unacceptable threats to human health and the environment are proven, but at present this will be very hard to prove. What can be claimed on the basis of freedom of choice as a liberty right is:

- A ban on certain crops if they endanger co-existence.
- GMO-free zones if co-existence is not possible.
- No use of the 0.9% (or any other) threshold as a maximum level up to which contamination is allowed.
- Application of the-polluter-pays principle in the case of contamination with GMOs.

IFOAM should, therefore, specify their notion of freedom of choice as referring to a liberty right.

The farmer's property rights and economic independence

In its Position Statement IFOAM (Anon., 2002) writes about the 'Violation of farmer's fundamental property rights and endangerment of their economic independence'. One could argue that as long as these are consequences of the globalization of the present free market economy, they are not specific for the application of gene technology. But the point is that gene technology as it is applied at the moment seems to be indissolubly linked to multinational companies (global players on the free market), and organic farmers to a very large extent still depend on conventional seeds. It is hard, therefore, to separate the two. And some consequences of this development directly affect the values of organic agriculture:

- Through the rise of multinational seed companies and the focus on GM seeds, the range of available varieties decreases and the use of their seeds is restricted by patent rights. As a result of this the right of farmers to re-use the seeds of their own crops is curtailed.
- Globalization through the use of GM crops goes against regional production adapted

to specific natural and cultural circumstances. The freedom and self-determination of the farmers is reduced when they become dependent on global players in the market. It also decreases agro-(bio)-diversity, which is one of the driving forces behind micro-evolution (De Wit & Verhoog, 2007).
- Globalization does not stimulate direct interaction with the consumers. Global chains lack transparency. DARCOF (Anon., 2000) has formulated the 'nearness principle' as one of the basic principles of organic agriculture, referring to the reduction of the alienation between the consumer and the food eaten, through direct contact between producer and consumer.
- In organic agriculture one wants to make use of the farmer's own experience in the improvement of plant crops and animal breeds (experiential knowledge). This experiential knowledge of the farmer refers to the plant or animal as whole organisms, living under specific environmental conditions. With the rise of molecular genetics farmers have become dependent on the specialist knowledge of geneticists and molecular biologists who work for special breeding centres. The high-tech approach usually goes together with exclusion of the farmer's own experience, thereby reducing his autonomy. Breeding companies do the field trials and use the farms, but the farmers do not take the decisions.

Incompatibility with the principles of sustainable agriculture

The argument that GM is incompatible with the principles of sustainable agriculture is problematic as long as these principles are not made explicit, but this is not done in the IFOAM Position Statement. Genetic engineering ('green biotechnology') is said to be a contribution to sustainable agriculture. Some proponents of genetic engineering even argue that conventional agriculture promotes sustainability and nature conservation better than organic agriculture (Trewawas, 2001). So using the concept of sustainability without explaining its meaning usually creates more confusion than clarity. This applies to organic agriculture as well.

Short history of the concept of sustainable development

Current literature often relates the concept of sustainability to the three P's: Planet, People, and Profit. Originally the focus was on 'planet': concern about the ecological consequences of the industrial use of the planet's resources, including depletion of resources and pollution of the environment. In many publications of that time, ecology and economy are seen as opposite to each other. In that respect, sustainable development is not compatible with the emphasis on economic growth combined with continued exploitation and depletion of natural resources. Important issues are ecological boundaries, stability, dynamic equilibrium, and steady state economy.

Later the emphasis shifted to 'people': meeting the needs of the present generation without compromising the ability of future generations to meet their own needs. Here the issue becomes more that of intra-generational justice (rich and poor countries, just distribution of resources) and inter-generational justice (future generations). In the last

phase attempts were made to integrate economy with the concept of sustainability by introducing the 'profit' concept: continuous economic growth to be able to satisfy the needs of people. The emphasis here is on technological innovations to reach the goals of sustainable development (sustainable technological development).

Concepts of sustainable development usually emphasize the needs of human beings and therefore represent anthropocentric approaches. Wild plants and animals are considered to be resources for human use; they are rarely valued for their own sake (intrinsic value instead of instrumental value). A non-anthropocentric or ecocentric view on sustainability is formulated in the report 'Caring for the Earth' (Anon., 1991). This report states that every human being is part of the community of life, made up of all living creatures. This community includes both cultural and natural diversity. In this view sustainable development is not restricted to survival, but also addresses the quality of life of living beings. Here questions about life styles and consumption patterns come to the fore. In this ecocentric view, 'needs' are looked at more critically.

Brand *et al.* (1995) have put the different views on sustainability together in the scheme of Figure 1. This historical scheme shows that sustainability is a complex, value-laden concept. It allows different stakeholders to place the emphasis on a few aspects of the whole and still claim to be promoting sustainability. For example, when the concept is used in connection with green biotechnology the emphasis is on (bio)technological innovation to produce enough food for the world population now and in the future. And 'within ecological boundaries' is usually interpreted as using less pesticide than before.

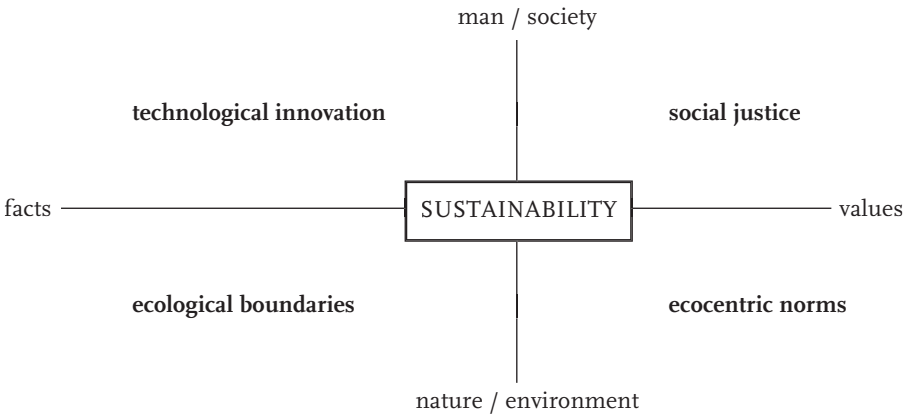

Figure 1. Different views on sustainability. Adapted after Brand *et al.* (1995).

The organic concept of sustainable development

The above-mentioned elements of sustainability are all present in organic agriculture. The organic concept of sustainability is ideally aiming at the full integration, in a balanced way, of the following four elements:

Ecological boundaries

The concept of ecological cycles is of crucial importance in organic agriculture. The whole farm area is seen as an agro-ecosystem, in which all parts ideally work together to create a balanced system with self-regulation. Creating biodiversity can help in reaching a self-regulating system. The Principle of Ecology is one of the four ethical principles accepted by IFOAM in 2005 (Anon., 2005). In organic agriculture everything is done not to pollute the environment (e.g. no synthetic pesticides) or to deplete the soil (which is seen as the foundation of the whole production system). This is not done because it may affect human health, or disturb ecological cycles.

Technological innovation

When one talks to organic farmers they frequently emphasize that working along ecological principles and creating a self-regulating agro-ecosystem demands much more innovation from the farmer than conventional agriculture. When one cannot handle diseases by applying chemicals, one must find other ('natural', 'systemic') solutions. Many farmers experience this as a real challenge, which for many makes organic agriculture an attractive profession. In empirical research on the values of organic farmers, the value of professionalism clearly came out as an important value (Padel, 2005). Taking into account ecological boundaries means that the farmer must have an intimate knowledge of the local conditions (e.g. soil, climate, natural enemies of pests). That is why scientists doing research for organic agriculture usually work together with the farmers with the aim to benefit from their experiential knowledge. For these scientists innovation is also something different than generalized knowledge from experimental plots. This shows that it is not correct to apply the term 'innovation' only in connection with high-tech developments such as genetic engineering.

Ecocentric norms

The term 'ecocentric' is developed in environmental ethics to categorize one of several human ethical attitudes towards nature (anthropocentric, zoocentric, biocentric and ecocentric). For more details see Verhoog *et al.* (2003; 2004b). Talking about ecocentric norms, Brand *et al.* (1995) mention organic agriculture as an example. If we use the term ecocentric in connection with organic agriculture, then we must interpret it as agro-ecocentric. The agro-ecocentric approach in organic agriculture includes elements from the other bioethical approaches as well. Man has a special responsibility in the ecosystem as a steward (cultural/anthropocentric element), but man at the same time is a participant in the larger ecosystem (ecocentric element) in which all living beings are seen as partners with an intrinsic value (biocentric element). The organic farmer also has a special responsibility with respect to the well being of sentient animals kept on the farm (zoocentric element).

Social justice

In recent years the element of justice or fairness has received increasing attention within the organic movement. It is one of the four ethical principles accepted by the IFOAM World Board in 2005. The Principle of Fairness says: "Organic agriculture should build on relationships that ensure fairness with regard to the common environment and life opportunities." In line with the ecocentric background of organic agriculture this fairness applies to both human relationships (social justice) and relationships with other partners within the ecosystem (ecological justice). The element of sustainability clearly comes back in the statement: "Natural and environmental resources that are used for production and consumption should be managed in a way that is socially and ecologically just and should be held in trust for future generations." (Anon., 2005).

Sustainability and naturalness

What is natural?

The various elements of the organic concept of sustainability can also be integrated in the concept of 'naturalness' as developed by Verhoog *et al.* (2003). This concept is very helpful if one wants to formulate the organic objections to genetic engineering. Genetic engineering is seen as 'unnatural'. To understand this I first refer to a report by Lammerts Van Bueren & Hospers (1991) in which growing lettuce in an economically very efficient industrial setting is compared with growing lettuce under organic (biodynamic) conditions. By an industrial setting is meant a fully automatized and computer-directed production system of lettuce in a hydroculture, with artificial light and mineral nutrition. It is a closed system without any contact with nature so that no pests can enter the system, and no pesticides have to be used. It is economically efficient and plants grow twice as fast as under biodynamic conditions. The lettuce plants are very vulnerable to disturbing factors from outside. This project was part of a Dutch programme about the development of 'sustainable' agro-technology. In the unheated glasshouse where the lettuce was grown under biodynamic conditions sustainability was achieved in a very different way, through care of the soil and the creation of an internally stable agro-ecosystem.

It is interesting to see how the media wrote about this 'ecotechnocratic' solution. One journalist said that, no matter how good the products may be, there will always be an emotional resistance to vegetables that lack 'any natural spontaneity'. Another journalist wrote: "Competitor of ecological and biodynamic farmers eliminates nature. In the lettuce factory the bond with nature is reduced to zero." This is the opposite of what organic agriculture tries to do, or in the words of the same journalist: "ecological farmers want to have a strong bond with nature" (Reyn, 1998).

Genetic engineering fits into this industrial approach to agriculture, because nature is not seen organically, but as a mechanism and an object of human analysis, control and interference. This argument is put forward in the memorandum by Wirz *et al.* (2003). It shows that the opposition to the use of GMOs in food is not only based on risks, but also on the 'industrialization' of agriculture and the consequences of it for the relation between humans and nature. The word 'industrial' here refers to the

trend towards production in non-ecological closed systems where everything is under human control. Even technology with terminator genes has been promoted as a technical 'fix' for gene escape from GM crops (Baumann, 2001). Perhaps we may say that every technology creates its own surroundings. This would mean that gene technology cannot be seen as a neutral technology that could be used in both conventional and organic agriculture (Lammerts Van Bueren *et al.*, 2007).

Behind the different meanings of sustainability are different views on the human relation with nature. The application of the industrial approach to living systems is felt to be 'unnatural' in organic agriculture because it does not fit into the nature of living systems (Verhoog, 2002/2003; Verhoog *et al.*, 2003; 2007). The argument of 'unnaturalness' is not used by IFOAM, although the idea that organic agriculture is a 'natural' way of farming is widely used in advertisements for organic products. In a leaflet from Platform Biologica (Anon., 1998), the umbrella organization for organic agriculture in the Netherlands, it is said that "organic (biological) is natural, and natural is free from gene-technology". However, the biotechnology industry also at times evokes the imagery of naturalness in order to promote its products. See for example Kleinman & Kloppenburg (1991). Here again it shows the importance of explaining what is meant with 'natural'.

In the high-tech (industrial) approach, the tendency is towards full control over nature by man: nature is eliminated. Its total opposite is pristine nature, untouched by human beings. With the latter meaning of nature it is of course impossible to speak about 'natural' agriculture, because every form of agriculture means intervention in nature.

The best way to describe the position of organic agriculture between nature and culture is to say that nature and culture are seen as two poles of a polarity relation, and both poles have to be cared for. We could call this the integration of nature and culture (Verhoog *et al.*, 2003a; 2007). This means agri-*culture*, but with respect for the independence and autonomy of nature. This respect for the independence of nature manifests itself in various ways, which leads to three further arguments against genetic engineering:

- The preference for substances that are as natural as possible, and the avoidance of purely synthetic substances.
- Stimulation of the self-regulation of living organisms and ecosystems (mimicking natural processes).
- Respect for the species characteristics, the 'nature' of living organisms.

The use of natural substances

The gene constructs put into organisms to create GMOs are synthetic constructs, not natural substances. The most important difference with traditional breeding is the direct intervention in the genome of plants and animals by forcefully introducing artificial and synthetic gene constructs (which can only be created in an artificial environment: *in vitro*). These gene constructs are human inventions. And in general (non-evolutionary time-scales), the gene constructs contain genes that would never be transferred by natural means. That they are not transferable by natural means is also part of the definition of genetic modification in official documents.

Stimulation of the self-regulation of organisms and the ecosystem (using natural processes)

In organic agriculture genetic engineering is seen as a technology that forces the organisms to do what humans want, instead of eliciting a reaction in which the natural entity retains its relative independence as a partner. Illustrative is the way humans have dealt with reproduction in the process of domestication of cows (and other domestic animals). Step by step (artificial selection – artificial insemination – embryo transplantation – genetic modification and cloning) the animal's own role in reproduction, its independence, is completely taken away from it and brought under human control (Verhoog, 2003). At the moment artificial insemination is allowed in organic agriculture by regulation, but not everybody in the sector agrees with the use of this technology.

Respect for the specific characteristics ('nature') of living entities

Respect for the specific characteristics of living entities is implied by respect for the intrinsic value of plant and animal species, agro-ecosystems and landscapes. The term intrinsic value (or inherent worth) indicates that human beings attribute living organisms a value 'of their own', a value that is inherent to them, and independent of its usefulness for human beings. Again a reference to the acknowledgement of the independence of nature, but now at a moral level. This attribution of intrinsic value is a free human decision, it is not 'derived from nature'. So the naturalistic fallacy does not apply. This fallacy only occurs when human beings defend an ethical choice by saying that it is natural to do so (occurs in nature as well), which is not the case here.

In this moral context also the word 'integrity' is used. (Animal) integrity is defined by Rutgers & Heeger (1999) as "The wholeness and completeness of the animal and the species-specific balance of the creature, as well as the animal's capacity to maintain itself independently in an environment suitable to the species." Strictly speaking, with the word integrity the emphasis is not so much on respect for the independence or 'otherness' of nature, but on the wholeness of an organism. The element of wholeness returns here in a normative statement. One could as well say that respecting the intrinsic value of a living being is referring to a more general attitude towards nature, whereas the concept of integrity is more specific, as can be seen from its use by Lammerts Van Bueren *et al.* (2003).

Conclusions

Most of the objections to genetic engineering mentioned in IFOAM's Position Statement (Anon., 2002) refer to the consequences of genetic engineering for the environment, human health or the social position of the farmers. These objections are not always convincing because they depend on the available scientific knowledge at a certain historical moment, and scientists usually do not agree on these issues. Because of the uncertainty involved in the establishment of both risks and benefits, arguments pro or contra genetic engineering are rarely decisive. The argument of freedom of choice as an argument against genetic engineering in general (for the whole of agriculture) is not convincing as it does not take into account the freedom of farmers

to choose for GMOs. However, defending the right of organic agriculture to remain free from GMOs is a strong argument, especially in discussions about co-existence of organic agriculture and agriculture using GMOs. The wish to remain free from GMOs is further strengthened by the organic philosophy underlying sustainability. IFOAM argues that genetic engineering is incompatible with the organic principles of sustainable agriculture. But these principles – and particularly the values behind these principles – have not been made explicit in its Position Statement. This was not done by IFOAM until 2005 (Luttikholt, 2007). In this paper I used the organic value of 'naturalness' to reconstruct the organic view on sustainability.

Note

This article is based on a paper presented at EurSafe 2004 (Verhoog, 2004a) and on a more extended article that was published in Forum TTN (Verhoog, 2004b). The publisher of Forum TTN has given permission to use the material. The chapter on sustainability in the present paper has not been published before.

References

Anonymous, 1991. Caring for the Earth. A Strategy for Sustainable Living. International Union for Conservation of Nature and Natural Resources (IUCN), IUCN Publishing Division, Gland, 227 pp.

Anonymous, 1998. Organic is Natural. Natural is Gene-tech Free. Platform Biologica, Biologica, Utrecht. 5 pp. (in Dutch)

Anonymous, 2000. Principles of Organic Farming. Danish Research Centre for Organic Farming (DARCOF), Foulum, 36 pp.

Anonymous, 2002. Position on Genetic Engineering and Genetically Modified Organisms. International Federation of Organic Agriculture Movements (IFOAM), Bonn, 4 pp.

Anonymous, 2003a. Co-existence between GM and non-GM crops. Position Paper. International Federation of Organic Agriculture Movements (IFOAM), Brussels, 5 pp.

Anonymous, 2003b. Gene Technology for Food. Report of the Swiss Ethics Committee on Non-human Gene Technology (ECNH), Bern, 20 pp.

Anonymous, 2005. Principles of Organic Agriculture. <http://www.ifoam.org/about_ifoam/principles/>. Accessed January 2007.

Baumann, M., 2001. The socio-cultural question: does genetic engineering advance sustainable development. In: D. Heaf & J. Wirz (Eds), Intrinsic Value and Integrity of Plants in the Context of Genetic Engineering. Proceedings *Ifg*ene Workshop, 9–11 May 2001, Dornach. Natural Science Section, International Forum for Genetic Engineering (*Ifg*ene), Dornach, pp. 50–53.

Brand, E.C., J. Swart & T. Pieters, 1995. Plant Biotechnology and Sustainable Agriculture. Biologisch Centrum, Groningen University, Haren, 59 pp. (in Dutch)

Damm, B., R. Schmidt & L. Willmitzer, 1989. Efficient transformation of *Arabidopsis thaliana* using direct gene transfer to protoplasts. *Molecular & General Genetics* 217: 6–12.

De Wit, J. & H. Verhoog, 2007. Organic values and the conventionalization of organic agriculture.

NJAS – Wageningen Journal of Life Sciences 54: 449–462.

Filipecki, M. & S. Malepszy, 2006. Unintended consequences of plant transformation: a molecular insight. *Journal of Applied Genetics* 47: 277–286.

Haring, M., 2001. Does gene transfer harm the integrity of the plant? In: D. Heaf & J. Wirz (Eds), Intrinsic Value and Integrity of Plants in the Context of Genetic Engineering. Proceedings *If*gene Workshop, 9–11 May 2001, Dornach. Natural Science Section, International Forum for Genetic Engineering (*If*gene), Dornach, pp. 35–39.

Haring, M., 2003. Blick ins Labor. In: C. Hiss (Ed.), Der GENaue Blick. Grüne Gentechnik auf den Prüfstand. Ökom Verlag, München, pp. 13–23.

Kleinman, D.L. & J. Kloppenburg, Jr., 1991. Aiming for the Discursive High Ground: Monsanto and the Biotechnology Controversy. *Sociological Forum* 6: 427–447.

Lammerts Van Bueren, E.T. & M. Hospers, 1991. Technologically Green versus Organically Green. Louis Bolk Instituut, Driebergen, 30 pp. (in Dutch)

Lammerts Van Bueren, E.T., P.C. Struik, M. Tiemens-Hulscher & E. Jacobsen, 2003. Concepts of intrinsic value and integrity of plants in organic plant breeding and propagation. *Crop Science* 43: 1922–1929.

Lammerts Van Bueren, E.T., M. Haring, P.C. Struik & H. Verhoog, 2007. Process or product orientation in the evaluation of novel breeding techniques for organic plant breeding. *NJAS – Wageningen Journal of Life Sciences* 54: 401–412.

Latham, J.R., A.K. Wilson & R.A. Steinbrecher, 2006. The mutational consequences of plant transformation. *Journal of Biomedical Biotechnology* 2006, Article ID 25376, 7 pp.

Lund, V., 2002. Ethics and animal welfare in organic animal husbandry. *Acta Universitas Agriculturae Sueciae Veterinaria* 137: 1–70.

Luttikholt, 2007. Principles of organic agriculture as formulated by the International Federation of Organic Agriculture Movements (IFOAM). *NJAS – Wageningen Journal of Life Sciences* 54: 347–360.

Mellon, M. & J. Rissler, 2004. Gone to Seed. Transgenic Contaminations in Traditional Food Supply. Union of Concerned Scientists, Cambridge, Massachusetts, 80 pp.

Padel, S., 2005. Focus Groups on Value Concepts of Organic Producers and other Stakeholders. Organic Revision Project. Report No D21. Institute of Rural Sciences, University of Wales, Aberystwyth, 129 pp.

Perlak, F. J., R.L. Fuchs, D.A. Dean, S.L. McPherson & D.A. Fischhoff, 1991. Modification of the coding sequence enhances plant expression of insect control protein genes. *Proceedings National Academy of Science USA* 88: 3324–3328.

Reyn, G., 1998. Vegetable exporter starts factory of lettuce free of artificial chemicals. Daily Newspaper De Volkskrant, 14 December 1998. (in Dutch)

Rist, L., 2000. Theoretische und experimentelle Untersuchungen über den Einfluss der Genmanipulation auf die Integrität der Arten. PhD thesis Gesamthochschule Kassel, Witzenhausen, 278 pp.

Rutgers, B. & R. Heeger, 1999. Inherent worth and respect for animal integrity. In: M. Dol, M. Fentener Van Vlissingen, S. Kasanmoentalib & T.H. Zwart (Eds), Recognising the Intrinsic Value of Animals. Van Gorcum, Assen, pp. 41–52.

Strizhov, N., M. Keller, J. Mathur, Z. Koncz-Kalman, D. Bosch, E. Prudovsky, J. Schell, B. Sneh, C. Koncz & A. Zilberstein, 1996. A synthetic cryIC gene, encoding a Bacillus thuringiensis delta-endotoxin, confers *Spodoptera* resistance in alfalfa and tobacco. *Proceedings National Academy of Science USA* 93: 15012–15017.

Thompson, P.B., 2002. Why food biotechnology needs an opt out. In: B. Baily & M. Lappé (Eds), Engineering the Farm: Ethical and Social Aspects of Agricultural Biotechnology. Island Press, Washington, D.C., pp. 27–42.

Trewawas, A., 2001. Urban myths of organic farming. Organic agriculture began as an ideology, but can it meet today's needs? *Nature* 410: 409–410.

Verhoog, H., 2002/2003. Biotechnologie und die Integrität des Lebens. *Scheidewege* 32: 119–141.

Verhoog, H., 2003. Naturalness and the genetic modification of animals. *Trends in Biotechnology* 21: 294–297.

Verhoog, H., 2004a. Organic agriculture and genetic engineering. In: J. De Tavernier & S. Aerts (Eds), Science, Ethics and Society. Proceedings 5th Congress of the European Society for Agricultural and Food Ethics (EurSafe), 2–4 September 2004, Leuven. Centre for Science, Technology and Ethics (CABME), Leuven, pp. 169–172.

Verhoog, H., 2004b. The reasons for rejecting genetic engineering by the organic movement. *Forum TTN (Institut Technik – Theologie – Naturwissenschaften)* November 2004, pp. 13–31.

Verhoog, H., V. Lund & H.F. Alrøe, 2003a. Animal welfare, ethics and organic farming. In: M. Vaarst, S. Roderick, V. Lund & W.Lockeretz (Eds), Animal Health and Welfare in Organic Agriculture. CAB International, Wallingford, pp. 73–94.

Verhoog, H., M. Matze, E. Lammerts Van Bueren & T. Baars, 2003b. The role of the concept of the natural (naturalness) in organic farming. *Journal of Agricultural and Environmental Ethics* 16: 29–49.

Verhoog, H., E. Lammerts Van Bueren, M. Matze & T. Baars, 2007. The value of 'naturalness' in organic farming. *NJAS – Wageningen Journal of Life Sciences* 54: 333–345.

Weaver, S.A. & M.C. Morris, 2005. Risks associated with genetic modification: an annotated bibliography of peer reviewed natural science publications. *Journal of Agricultural and Environmental Ethics* 18: 157–189.

Wirz, J., 2002. Towards a science of organism: lessons to learn from phenomenology. In: D. Heaf & J. Wirz (Eds), Genetic Engineering and the Intrinsic Value and Integrity of Animals and Plants. Proceedings *If*gene Workshop, 18–21 September 2002, Edinburgh. International Forum for Genetic Engineering (*If*gene), Edinburgh, pp. 79–84.

Wirz, J., N. Fuchs & R. Richter, 2003. Memorandum zur Koexistenz von Gentechnik-Landwirtschaft, konventionellen und ökologischen Betriebsweisen. Goethenaum, Dornach, 5 pp.

Zhao, J.Z., J. Cao, H.L. Collins, S.L. Bates, R.T. Roush, E.D. Earle & A.M. Shelton, 2005. Concurrent use of transgenic plants expressing a single and two Bacillus thuringiensis genes speeds insect adaptation to pyramided plants. *Proceedings National Academy of Science USA* 102: 8426–8430.