I. Respondent´s profile

Further development of the bioeconomy is essential if Europe is to address the grand challenges that face not only European but also global societies and economies. European plant sciences are willing and able to actively participate in this process by playing a leading role in research, education and innovation that will lead to the sustainable bioeconomy of the future.

Sustainable agricutlure in Europe and globally is a major component of this approach, in which the EPSO members are very much engaged. It is the view of most crop scientists that the evidence would favour a much more integrated approach to agricultural technologies and practices in which the three criteria of crop yield, crop quality and long-term environmental sustainability are the objectives. A combination of approaches taken from conventional, organic and GM agriculture is the most likely way that these three criteria could be optimised and implemented on a timescale that matters with the burgeoning population for EU and global food security needs.

EPSO – the European Plant Science Organization (www.epsoweb.org) – is an independent academic association with more than 220 research institutes and universities from 30 countries mainly in Europe, and 2 900 individuals, as members, representing over 28 000 people working in plant science. EPSO has been actively involved in the development of strategies and has provided some of the initial impetus for the implementation of the bioeconomy in Europe. Since its founding 12 years ago, EPSO and its members have actively fostered collaboration between the scientific, farming and industrial communities across disciplines and sectors of the bioeconomy. Beyond support for frontier research, EPSO fosters collaborative research across stakeholders and disciplines as a key member of the European Technology Platform "Plants for the Future". EPSO has also had a central role in the establishment of the Strategic Research Agenda of the ETP and its links to the bioeconomy of the future. On behalf of the Plant ETP, EPSO coordinated the BECOTEPS-project linking 9 ETPs active in bioeconomy, developing joint perspectives and recommendations for research, education and innovation to make the Bioeconomy in Europe a reality.

II. EPSO comments and suggestions on Organic Agriculture in Europe

Organic farming currently accounts for 4.3% of total EU acreage and not more than 2% of total food expenses in the EU-15 (http://ec.europa.eu/agriculture/organic/files/eu-policy/data-statistics/facts_en.pdf). As a 'niche' compared to conventional agriculture, organic products aim at a market segment with special requirements and structure and frequently command a premium in the market place mainly from consumers who are prepared to pay extra for one or more perceived benefits of this form of agriculture.

Much of the EU perspective on organic farming is ideological, not evidence based and needs to be scientifically evaluated, as do all options of agricultural practices. This objective approach is essential for the real benefits and risks to be measured and compared including: yield potential, ecological impact and carbon footprint as well as nutritional value.

Postponing judgment until evidence is gathered and objectively evaluated is essential as it is only then that firm conclusions can be drawn.

In the call for public consultation from the European Commission (http://ec.europa.eu/agriculture/consultations/organic/2013_en.htm), there are several instances that must be called into question. In the preamble we find the following statement: "Organic farming and production play a significant economic role in the EU's agricultural landscape. They can provide a market-oriented alternative for agricultural producers wishing to respond to the increasing demand for high-quality, eco-friendly products". The implication of this is that the "Eco-friendly" credentials of organic cultivation have been established scientifically in all cases. Later in the same pre-amble we read: "In the current economic downturn, will consumers continue to turn towards a more sustainable lifestyle and higher consumption of organic products? Here the tacit implication is that organic agriculture is always more sustainable. This kind of preamble pre-judges that which needs to be established for the consultation document to be meaningful.

Although EU regulations about organic produce are designed for the most part to ensure a quality standard is attained, it is evident that there is a bias towards developing the organic sector as is clear in the statement: "in 2004, the Commission launched an Action Plan to develop organic farming in Europe, which gave further impetus to the sector". Apart from quality assurance, the main reason why the Commission should interfere with the development of the sector is because it may help to protect a specific sector of farmers, essentially small farmers. If this is the reason, it should clearly be stated as such.

Instead the reasons for the Commission policies appear to be based on unstated and certainly unproven assumptions that there is some preferential public good offered by this form of agriculture based on nutritional, environmental or sustainability criteria. Not only is it necessary to establish this, but it is absolutely required that evidence would be presented, which refutes the many studies (in international peer reviewed journals) that organic agriculture is not superior, sometimes even inferior, to conventional agriculture in some fundamental environmental criteria such as carbon footprint, sustainability and, due to frequently lower yield, the amount of land required to produce a given amount of product. In many other cases organic farming is indistinguishable from conventional agriculture having its own unique sets of drawbacks, such as the use of antiquated inorganic pesticides such as copper sulphate.

Is the carbon footprint of organic agriculture superior to that of conventional farming?

Life Cycle Assessments (LCAs) are usually based on carbon or energy budgets and on a per unit area basis and they tend to show organic systems as being somewhat more sustainable in this limited sense. However, when an analysis is performed, based on a per unit of food (eg tonnes per hectare), then organic systems generally perform worse than conventional systems, because of excessive land use. Tuomisto et al. (2009) found, using LCA, that integrated farm systems that produce high yields, but use environmentally beneficial practices have the least negative environmental impacts, with conventional methods being the second highest footprint and organic methods performing the poorest. In a more detailed meta-analysis, Tuomisto et al. (2012) revealed that organic farming practices generally have positive impacts on the environment per unit of area, but not when evaluated per product unit (per tonne of yield). This normalization is essential to a side-by-side comparison.

Is biodiversity preserved more by organic farming practices?

One might expect more biodiversity in fields on organic farms because they tolerate some weeds and pests, and so are likely to have a more complete food chain of insects, birds and mammals. However, this tacit assumption is flawed when normalised to units of production. Studies are currently focusing on whether it is best to farm extensively (e.g. organic), often called 'land sharing', or intensively but leaving some land such as field margins for biodiversity, called 'land sparing'. However Hodgson *et al*. (2010) clearly showed that butterfly populations were lower in organic cultivation than in conventional cultivation and that organic yields would have to exceed 87% of conventional yields (extremely rare) to be equivalent. The need to deliver food security while maintaining broader ecosystem services (biodiversity, air and water quality, landscape, etc) has resulted in the now widely accepted view of the need to assess efficiency per unit of product. This is needed to avoid a move towards more extensive farming systems that merely export environmental damage, such as the destruction of rainforests and other vital ecosystems in countries from which we import food. On an amount of product basis, extensive systems often perform poorly; see for example Glendining*et al*. (2009) and Van Groenigen*et al*. (2010).

Is organically grown food more nutritious or safer than food from conventional farming?

Organic marketing organizations frequently make claims about the nutritious nature of organically produced food products. The EU has tacitly accepted this position and in doing so allowed the consumer to be misled. In fact, numerous studies have been performed in order to determine if any substantial differences could be found. The most authoritative study on this matter is from the London School of Tropical Medicine and Hygiene (Dangour et al, 2009). In this study, published in the American Journal of Clinical Nutrition the authors studied 11 nutrient categories (vitamin C, phenolic compounds, magnesium, potassium, calcium, zinc, copper, and total soluble solids, nitrogen content, phosphorus and titratable acidity. In their conclusions, the authors state “On the basis of a systematic review of studies of satisfactory quality, there is no evidence of a difference in nutrient quality between organically and conventionally produced foodstuffs.

In relation to food safety some people have blamed organic agriculture for a number of recent accidents that occurred of bacterial infection in the USA and in the EU. While it cannot be established that organic farming, due to the use of biological fertilizers has always to have lower standards of safety, it is also clear that safety arguments cannot be used either in favour of this type of practices.

Is coexistence between the cultivation of genetically modified (GM) and non-GM crops achievable?

Freedom of choice between GM and non-GM products, including organic, is essentially based on the principle of coexistence recognised by the EU. Coexistence refers to the conditions under which GM and non-GM agricultural products can be grown in the same territory, transported and marketed side by side, preserving their identity in accordance with the relevant labelling rules and purity standards (www.price-coexistence.com). Following the Commission Recommendation of 13 July 2010 on guidelines for the development of national co-existence measures to avoid the unintended presence of GMOs in conventional and organic crops, best agricultural management practices for coexistence have been developed in the European Member States which differ significantly (http://ecob.jrc.ec.europa.eu/). Since organic production systems are not isolated from other production chains including those using GM crops, the accidental presence of GM plant material in organic farming and resulting produce cannot be completely ruled out. Therefore, a zero tolerance for GM plants and products approved for placing on the European market is not realistic. Though the labelling of food and feed resulting from GM plants is required under the current EU law, there is no need to indicate the possible presence of GM plant material on the label of any food/feed product where it accounts for less than 0.9% of the product content. Based on this labelling threshold of 0.9% for the unintended and technically unavoidable GM admixture coexistence can be organized. Stricter labelling requirements based on lower labelling thresholds are likely to increase costs for producers and consumers and will interfere with the freedom of choice as a central goal of the European agricultural policy.

It is also illogical that the coexistence problem is only seen in one direction. The increasing diversification of agricultural production (e.g. fortified crops, hypoallergenic crops) might require thresholds for and consequently labelling of impurities resulting from other production chains, including organic. For example, there are many consumers in Europe who actively avoid organic produce and thus the reciprocal problem must also be taken into consideration.

Adopting an Evidence Based Approach

The aims to reduce inputs in agricultural practices and the environmental impact that some treatments may have are reasonable targets for European policies. Some organic agriculture practices have shown that this may be possible; they may also be an interesting product for small farmers in some European regions. However, the information given to the public for the reasons why European Union are promoting different types of agriculture have to based in the best available scientific evidence.

Postponing judgment until evidence is gathered and objectively evaluated can change the conclusions drawn about some aspects of the organic approach. For example (Bahlai et al. 2010) showed that some organic approved insecticides had a similar or even greater negative impact than synthetic ones on non-target beneficial insects in lab studies, and were more detrimental to biological control organisms in field experiments, and had higher Environmental Impact Quotients at field use rates. Seufert et al (2012) found that organic fertilisers do not always supply enough nutrients to crops during the peak growing period and thus compromise yield. The yield reduction meant that certified organic production systems were less efficient per unit land area. This is consistent with the meta-analysis of Tuomisto et al. (2012) referred to above. In fact, there is a considerable effort in all type of agricultural management systems at this moment to reduce inputs in fertilizer or pesticide use to minimize their possible effects in the environment.

We have created an artificial distinction between organic and GM approaches. In fact much of the regulatory framework in the EU enshrines this arbitrary idea (http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2012:0212:FIN:en:PDF). Crop genetic improvement has already reduced the need for pesticides or fertilisers and farmers using fewer inputs such as organic farmers are the ones who could benefit the most. They already widely use crops that were developed from mutagenesis screens such as Golden Promise barley. Why is it that mutagenesis approaches that involve exposure of seeds to high doses of radiation or mutagenic chemicals to create random mutations are unregulated, but more targeted GM approaches are heavily regulated? Organic and GM crops may be more compatible than assumed (Ronald PC, Adamchak RW. 2008; Ronald 2011). The current rules seem to be more related to the 20 year old fears of consumers, all of which have now been answered by long-term nutritional research and environmental assessments, than to any real world risks to health or the environment. An integrated approach including the best features of organic and conventional systems based on scientific evidence would be more effective.

It is the view of most crop scientists that the evidence would favour a much more integrated approach in which the three criteria of crop yield, crop quality and long-term environmental sustainability are the objectives. A combination of approaches taken from conventional, organic and GM agriculture is the most likely way that these three criteria could be optimised and implemented on a timescale that matters with the burgeoning population for EU and global food security needs.

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