Reconciling Organic Crops and Biotechnology.

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Food security is controversial. On the one hand there are the stark estimates that, in 2010, there are hundreds of millions of malnourished people and that, to achieve food security in 2050, we will need 50% or more food than at present. On the other hand there is massive waste, significant over-consumption of calories and meat features too prominently in diets. Perhaps current food production would suffice if we use food more carefully and eat less meat?

In a perfect world it is true that we could persuade everyone to recycle everything by feeding waste food to garden chickens, for example. We would at least stop eating grain-fed beef because it is so resource intensive. However, in the real world, we are not always compliant with best practise and demand for food will increase as the population grows in parts of Africa and other regions. In addition, the means of food production will be challenged by climate change, water shortage, soil erosion, the need to reduce greenhouse gas emissions, the need to preserve biodiversity and limited land availability.

In the light of these factors it is difficult to reject the conclusion that we need new technology for food crop production. The technology we need will allow global yield to increase but without using additional land and without degrading the environment. I chaired a recent study by the Royal Society that proposed 'sustainable intensification' as a response to this need – high yields delivered permanently without increasing the area of cultivated land[1].

At present there are alternative views about the type of this new technology. On the one side there are organic farmers proposing agro-ecological methods and approaches that avoid synthetic chemicals or genetic manipulation. The biotechnology industry, in contrast, has focussed on crop improvement by breeding or GM. It does not reject artificial fertilizers and has not explored agro-ecology to a large extent.

Until now organic production and biotechnology have been seen as opposite. Organic farmers have complained about pollen contamination from GM crops .Biotechnologists have been frustrated by what they see as over-regulation of their technology due to inappropriate application of the precautionary principle stimulated by concerns of organic farmer.

However there is a third way that takes the best of both approaches. It would use GM crops, for example, that are consistent with no-till agriculture, do not require toxic insecticides, resist late blight and viruses or that that have enhanced nutritional content[1]. From a trait perspective I find it difficult to see how there can be an objection to these developments.

This third way would also use practise from organic and traditional agriculture. A good example involves cultivation of maize together with a legume and a forage grass. This companion cropping system allowed yield to be doubled in East Africa without increased fertilizer input, without using pesticides to get stem borer control and without using herbicides to control Striga – a parasitic weed[2].

This ingenious strategy must surely inspire the development and refinement other methods of crop management. Used alone they will allow good yields and pest management but without the use of fossil fuel inputs. Used in combination with biotechnology they could allow yields in developed country agriculture to be maintained at the level of current industrialised agriculture but with a lower environmental footprint. In less developed countries, especially those in Africa where average yields are very low, there could be a massive increase.

To achieve this reconciliation of organic farming with biotechnology we probably need to step back and take a rational assessment of several issues. Is it wise, for example with herbicide resistant crops that can be used for weed control and no-till cultivation, to use a single gene in a high proportion of the crops grown? The answer is probably “no” because the widespread use of the herbicide will result in selection of herbicide resistant weeds[3].

Is it rational, taking a different perspective, to think of GM as tinkering with Nature? Again the answer is “no” unless one also thinks of conventional breeding as tinkering: GM crops have one or a few novel genes introduced into the existing set of 30000 whereas the breeding of bread wheat, for example, involved creating a plant with three new sets of 30000 genes in which the potential for highly complex interactions is very real.

Stewart Brand, an advocate of organic foods and entrepreneur behind the “Whole Earth Catalogue” in the USA, has recently changed his mind about GM and now promotes its use[4]. Perhaps if a large biotechnology component or one of their executives could make reciprocal concessions about the value of practise in organic farming then we would be on the way to meeting the food security challenge. We desperately need this reconciliation of different approaches because neither is likely to provide the complete solution to sustainable intensification of global agriculture.

[1] Reaping the Benefits: Science and the Sustainable Intensification of Global Agriculture. http://royalsociety.org/reapingthebenefits/
[2]Pickett JA, Hamilton ML, Hooper AM, Khan ZR, Midega CAO Companion Cropping to Manage Parasitic Plants. Annual Review of Phytopathology, Vol 48. Palo Alto: Annual Reviews. pp. 161-177
[3]Powles SB, Yu Q Evolution in Action: Plants Resistant to Herbicides. Annual Review of Plant Biology 61: 317-347.
[4]Whole Earth Discipline: An Ecopragmatist Manifesto: Stewart Brand