Novel Plants for Tropical Agriculture: How will we achieve this and who will do it?

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Few amongst us realise that the sharp increase in world population is an event of the last fifty years. At the end of the second World War, the planetary population numbered two billion people, yet today we are nearly six billion, and even accounting for the decline in the birth-rate, it is expected that this figure will climb to ten or twelve billion in the first half of the next century. Eighty percent of this growth is expected to take place in tropical areas and it is just this that represents the major challenge to food production, the environment and to medicine.

There are only two ways in which we can increase agricultural output ; either by enhancing productivity, or by increasing the area cultivated. In the latter case, this can only occur at the expense of the limited natural habitats still remaining. The green revolution has shown that human ingenuity can achieve substantial yield improvements by creating new cultivars and by improving agricultural practices. Such new varieties demand a high input of fertilisers and other environmentally-unfriendly chemicals such as herbicides and pesticides. These new cultivars are also based on a narrow genetic background, which means that there is a permanent threat that a virulent disease could develop for which these plants have lost their natural resistance. Furthermore, this intensive agricultural approach has only been developed for a limited number of crops which are cultivated mostly by the industrialised world and not for the plants used by the subsistence farmer in tropical agriculture.

If today, intensive agriculture is already considered quite polluting, then this is unfortunately even more the case with our industries. Yet we can only hope to obtain global peace and equilibrium if the poor and overpopulated tropical regions can also industrialise. Hence it becomes clear that we have a responsibility to concentrate all our efforts on creating new, environmentally-acceptable industries.

Primary amongst the medical problems that we can expect in an overpopulated world, will be the appearance of new infectious diseases. To help the poor areas will require a reorientation of the entire medical system towards the development of inexpensive vaccination systems, drugs and antibodies. Here again, the bio-engineering of plants to produce more and better secondary metabolites and proteins has unique potential. Hence I firmly believe that all three of these problems can be tackled by intensifying the research and development of plant biotechnology.

As soon as the *Agrobacterium* mediated gene engineering of plants opened the molecular studies into plant growth and development, biotech R&D companies tried to engineer improved plants. Early attempts, involving the transfer of altered genes from bacteria showed good expression levels, and created confidence that this was indeed a valid approach. Slowly, the major agrochemical companies have started to invest in this new endeavour.
Some of the major results resulting from this direction are ; the production of plants that are able to defend themselves against a given insect pest by synthesising an insecticidal protein ; the engineering of major crop species to degrade new, environmentally-acceptable herbicides, leading to the possibility of a non tillage agriculture. Hybrid vigour, which since the mid-thirties has been used to substantially improve yields in corn, has been obtained at reduced cost through engineering male sterility into plants. This approach has lead to the development by the Ghent-based company Plant Genetic Systems, of *rapeseed (Canola)* with a 25% increase in yields and to the extension of the hybrid vigour concept to many new plants. Other successes, which include delayed fruit ripening, an aid to storage

and transport, alteration of the seed oil content, and more recently, the production in plants of such medically important proteins as antibodies and enzymes, all indicate the growing economic importance of transgenic plants. The plant genome project, just as the human genome project, is providing us those genes that might influence important traits, and suggesting what alterations can be engineered into the plant to lead to improved crops and novel industrial plants.

We also have available new DNA fingerprint techniques that are helping to accelerate the analysis of the outcome of crosses and making it possible to start genetic analyses on plant species never even previously cultivated. This opens the door to the identification and capture of the commercial and scientific value contained in the huge diversity of plant species still present in untouched habitats. Hopefully, this will help to convince many countries of the importance/value of the biodiversity they possess and to cease the rapidly, irreversible extinction that results from the destruction of these irreplaceable habitats.

In recent years major agrochemical industries such as Novartis, Dupont and Monsanto along with several smaller companies, have shown that they are convinced that next century will be the century of the life sciences. Through their intense mergers and acquisitions they have manoevoureed themselves into a position, where, as owners of patents and of proprietary knowledge in the field of plant biotechnology, they merely have to decide when and where a new plant will be commercialised.

So what does all this mean for tropical agriculture? Improvement depends on the quality of the country's agricultural research stations and on the initiatives of the local seed companies. Internationally, there is help from many of the richer countries through the World Bank-sponsored Consultative Group of International Agriculture Research, the CGIAR. For more than 25 years this has funded research on mandate crops in sixteen CGIAR institutes spread over most of the tropics. However, due to the population explosion time is running out, and the results of plant biotechnology R&D will have to be rapidly and efficiently implemented in order to create in due time the improved plants needed by tropical agriculture. Can this be achieved technically? Will there be the freedom to operate? Indeed, if the OECD asks all countries to sign the international legislation on intellectual property rights, it is clear that tropical plant engineering will come to depend almost entirely on the existing patents, owned by the major multinational companies. Is it then possible that tropical agriculture will become the privilege of the elite farmers who use the engineered seeds produced under license of these major companies? Can the enormous variety of cultivars used by the subsistence farmers be improved notwithstanding possible patent infringements? I believe that co-operation between the scientists of advanced institutes and the specialists in tropical agriculture can bring about major new discoveries in molecular plant physiology. This new knowledge will in turn lead to inventive steps and new tools in a technology that is needed by all, including the leading multinationals of today. Further, if well protected by patents, the inventions obtained through this co-operation can allow an exchange of licenses, thus bringing the necessary operating freedom to tropical agriculture. I consider that the knowledge and much of the enabling technology exist already in the advanced institutes, and that more will be developed . But time is short that we need to act immediately.