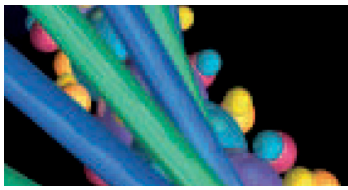

BIOTECHNOLOGY RESEARCH FOR A COMPLEX WORLD
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# FROM PLANT BIOTECHNOLOGY TO BIO-BASED PRODUCTS

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Since its inception in 1990, the US-EC TaskForce on Biotechnology Research has been strongly committed to exploring the progress and applications of plant biotechnology. Topics of the TaskForce Workshops have both predicted and reflected the changing patterns of interest, capability and utility of the technology.

1990 preceded the era of large-scale genome sequencing and integrated genomic approaches. Typically, researchers were working on genes, not genomes; bioinformatics was in its infancy. In 2010, we know far more about gene function and regulation. We have many more molecular tools and analytical technologies, vast amounts more data and integrated bioinformatic platforms to interrogate the data. Our understanding of molecules, cells and systems has grown immensely. We are now able to study many events holistically and in entirety from the chemistry of a molecular mechanism to the biology of an individual organism within its ecology.

These statements can be applied generally to all of the biosciences and their associated technologies. However, a unique feature of plant biotechnology over the years has been the changing focus of its applications. Twenty years ago, plant biotechnology was regarded principally as a tool for understanding plant biology and for solving problems in arable agriculture, such as increasing yields, reducing inputs and increasing the resistance of food crops to abiotic and biotic stresses. Ten years ago, attention started to shift from food crops to non-food industrial crops. Today, society wants to gain the maximum value for food and non-food applications from all crop species and plant biotechnology provides one important enabling tool. The zero-waste, integrated biorefinery is already in place as a concept, if not yet typically as a working, commercially sustainable reality.

The interest that emerged in replacing oil and petrochemical feedstocks with plant-derived bio-products and agricultural feedstocks was initially driven by the price and security of fossil reserves. The philosophy of a "knowledge-based bio-economy" was further endorsed by the increasing recognition of environmental risks to the planet, rising levels of greenhouse gases and climate change. Renewable energy sources became national priorities. Chemical companies designed new bio-based discovery programmes to replace petrochemical feedstocks too costly to use for high volume, low value consumer products. Over recent years, plant biotechnology has been increasingly used in innovative strategies for both food and non-food applications. EPOBIO, an outcome from a 2004 US-EC TaskForce Workshop, clearly highlighted the value of plant biotechnologies to the emerging bio-economy.

Land use decisions will only increase in importance. A rising world population with greater urbanisation requires food and increasing amounts of animal feed to support the meat and dairy industries. Crops for food and animal feed compete for land with crops for energy and bio-fuel, crops for chemicals, and crops for all the many other applications already reliant on plant products. Productive land is finite. Water scarcity in many of the major agricultural regions of the world is already an issue. Land use decisions will become critical to whether a sustainable, knowledge-based bio-economy can ever be achieved.

These political decisions will be made in the context of the new and emerging bioscience and biotechnologies. Central to the future is germplasm development. Developing new plant varieties optimised for local conditions of cultivation produced using fast-track breeding platforms that will increasingly rely on deep sequencing to capture the genetic variation that already exists, as yet largely unidentified in natural populations. This new era of germplasm development will take place within the context of agronomics, economics and significantly, environmental science. The development will also take place to ensure maximum value can be realised from an agricultural feedstock - no longer discarding co-products as waste streams - but rather realising the full potential of all of the components manufactured by the plant production system.