

Launch of the European Technology Platform Strategic Research Agenda “Plants for the Future”

Why Europe needs strong and internationally competitive plant research

Wilhelm Gruissem

President, European Plant Science Organization

History teaches us that the success of societies and their economies has always depended on their agricultural production and capacity to feed people. At the beginning of the 21st century food security and well-being of the human population have emerged as the biggest challenges faced by the nations of the world. As humans are exhausting fossil fuels for energy and soils for agricultural production at an accelerating pace, Europeans are becoming increasingly aware that our current handling of natural resources is not sustainable. The reality that climate change is threatening our lifestyle has Europeans and other nations now calling for alternative fuels from renewable resources. Not surprisingly, this is now pitting agricultural food production against the use of crops such as corn, wheat or rape for biofuel production. As a result, there is a real concern that in the battle for biofuels the world is facing an unprecedented increase in retail food prices as farmers are scrambling to devote more land to crop production for biofuels. In fact, on June 11 the Chinese government announced a moratorium on the production of ethanol from corn and other food crops to stem the rapidly rising costs for corn and grain.

These and other problems once more threaten the European economy. They demonstrate that Europe needs strong and internationally competitive plant research. Europeans must appreciate that plants will continue to be the most important basis for their economic prosperity—and not something we take for granted. They must be prepared to invest in plant research to develop new agricultural crops, sustainable agricultural production and new industrial resources

European plant scientists perform groundbreaking research...

Europe has a long tradition of excellent and innovative plant research. For example, genetic transformation of plants, which is now driving the green biotechnology

revolution, was discovered by our distinguished European colleagues Marc Van Montagu and Jeff Schell. Another example is Arabidopsis, which European researchers such as Maarten Koorneef first developed as a model plant organism more than 20 years ago and which thousands of plant scientists around the world are now using for their research. In fact, the 18th Arabidopsis Conference in Beijing last week was attended by over 1,500 scientists from 60 nations. The Arabidopsis genome sequence, which was completed in 2000, has produced exciting new insights and opportunities to learn about the function of agriculturally important genes. The genome of rice, which serves as an important model for grain crops, was fully sequenced by Syngenta, a leading European agricultural chemical and biotechnology company. They competed successfully with a large institute in China that sequenced the rice genome at the same time. And finally, the concept of 'sustainable agriculture' and 'sustainable use of resources' originated in Europe. Many other nations around the world are now embracing these concepts to innovate their own economies.

...but Europe fails to harvest the fruits of plant research

These examples demonstrate that it is often European plant scientists who make breakthrough discoveries and develop important new concepts. But Europe is not effectively exploiting this leadership and often leaves it up to other nations to put discoveries and new principles into agricultural practice. For example, the current worldwide adoption rate of high-value GMO traits that were developed in the U.S. and elsewhere is unprecedented in the history of agriculture, but this revolution is bypassing Europe! It is also stifling the development of modern plant-based economies in African countries that rely on Europe as their market. Another example is the investment into biomass and bioethanol production technologies, for which the United States of America will invest nearly \$ 2 Billions by the end of this year. Other countries such as China, Russia and Brazil are also realizing their potential to innovate agriculture and therefore invest in plant research for sustainable production of biomass resources.

Europe needs a strategic agenda to exploit innovative plant research

The Strategic Research Agenda of the European Technology Platform 'Plants for the Future' has been crafted by a broad alliance of stakeholders involving industry,

farmers, consumers and plant scientists to help Europe regain leadership in agricultural innovation, novel uses of plants, and sustainable production of industrial resources from biomass. This is a big challenge, especially when during the past few years the support of vigorous plant research was not a high priority on the political agenda in Europe. We are convinced that the strategic perspective of the European Technology Platform will put plants back on the agenda of Europe's policy makers by focusing on key issues in plant and agricultural research that Europeans must address. The Strategic Research Agenda of the European Technology Platform also provides politicians important concepts for the strategic and effective deployment of limited funding resources for plant research. This will help them to assure that the European plant-based economy not only stays internationally competitive but will again lead the world in agricultural innovation and resource development.

A 'small RNA world' promises exciting new plant research and applications

Today the genomes of Arabidopsis, rice and poplar have been fully sequenced, and many more plant genome sequencing projects are in the pipeline. New functional genomics technologies have been developed to reveal the expression of every gene in the genome. This information puts our understanding of the function of every gene within reach and opens new opportunities for breeding and agricultural innovation. But the systematic analysis of genome function has also revealed a startling new 'small RNA world' that will completely change our current view of gene expression regulation and evolution. The discovery of small regulatory RNAs was acknowledged by the award of the 2006 Nobel Prize to Craig Mello and Andrew Fire. 'The Economist' has rightfully called this discovery the 'big bang in biology'. The workings of the 'small RNA world' was first observed in plants, but it took nearly ten years until experiments by Mello and Fire in the tiny worm *C.elegans* could explain the significance of the early observations. We now know that in addition to regulatory proteins, many other regions of plant and animal genomes express small RNAs that control our genes. This 'small RNA world' allows plants and animals to adapt to changing conditions and may even transmit information to our children and the next generation in plants.

At present we can only imagine the impact that this discovery of the 'small RNA world' will have on agriculture and medicine. Over the next 10-15 years plant researchers will engineer regulatory mechanisms to produce new crop plants with a high and stable yield. Small regulatory RNAs will be used to shape the leaves of crop plants for improved photosynthesis and carbon dioxide fixation. We are already using small RNA-based strategies to combat plant pathogens and we can imagine the use of small RNAs for making plants more resistant to drought. Most importantly, however, by optimizing biochemical pathways using small regulatory RNAs we can make plants and agriculture less dependent on fertilizers and pesticides. We will use entirely new strategies to optimize plants using their own natural arsenal of small regulatory RNAs. Small regulatory RNAs will have a similar impact in medicine, and we can easily imagine using them to turn off genes that cause diseases. Plant and medical researchers will establish new paradigms for genetic engineering that will be embraced by Europeans because of their benefits to agriculture and medicine.

Crop diversity—the future of European agriculture and industry

The world is growing smaller and today Europeans are enjoying a greater variety of food from all corners of the world than ever before in the history of Europe. But while enjoying this luxury we forget that more than 75% of world food production relies on only a handful of staple crops, including wheat, rice, corn and potato. This is surprising, because since the dawn of humankind we have cultivated nearly 7,000 plant species. But even this surprising number represents only less than 2.5% of plant diversity on earth. Today 90% of the calories from food that people eat come from only 30 crop plant species. This represents 0.01% of plant diversity! While breeding for yield and relying on artificial fertilizers to feed Europeans, we have lost sight of the enormous diversity of plants that can provide healthier and more nutritious food as well as new resources for agriculture and industry.

Europeans value traditions, and therefore politicians must encourage them to embrace new research to exploit the diversity of cultivated plants for food and industrial applications. The alliance of farmers and industry on the European Technology Platform will work closely with plant researchers to provide advice on

strategically important traits that will give European agriculture and industry competitive advantages and Europeans healthier food to eat.

Plant diversity represents a rich source of genetic diversity that plant researchers must access for new genes to fight pathogens, to improve the nutritional value of our current crops, and to help our crops adapt to climate change. Only 10% of our plants have been analyzed for pharmaceuticals. Plant diversity also means access to new sources of biomass and new enzymes to make biofuel production more cost-effective and sustainable. Research on plant diversity will avert competition for the use of crop plants for biofuel and food production. During the next 15 years, new technologies such as ultra-fast and cheap DNA sequencing will allow plant researchers to tap the genetic reservoir that we need to make European agriculture competitive and sustainable while preserving valuable natural resources for future generations.

Novel crops—the basis of a new European bio-economy

The European Technology Platform ‘Plants for the Future’ brings the vision and strategic research agenda to transform agriculture into a new knowledge-based bioeconomy by transferring knowledge into application. In the next 20 years Europeans will see plants with new health properties to fight diabetes and cardiovascular diseases. We will have better tasting plants with optimized nutritional compositions to support a healthier lifestyle. Healthcare costs will be reduced by plant-based production of pharmaceuticals and we will discover new pharmaceuticals in the rich diversity of plants. Plant researcher will develop plants with self-destructive cell walls and starch to make biofuel production more efficient, cost effective and sustainable.

Plants for Europe—a strong alliance for our future

The European Technology Platform ‘Plants for the Future’ looks forward to a strong cooperation with EU MPs, politicians, national agencies and other stakeholders to implement the Strategic Research Agenda for the benefit of all Europeans. Together we must work at the European level using instruments such as the Framework Programs, the European Research Area Networks, the emerging European Institute of Technology and key Lead Markets. At the national level, we must access public

and private resources to implement the Strategic Research Agenda and provide strategic support and guidance to national plant research programs.

The European Technology Platform together with the European Plant Science Organization will work to assure that strategic plant research receives highest priority and support. For example, in the 2007 and 2008 Workprogrammes of Framework Program 7 only 30% of the plant research topics were chosen from a strategic point of view. This number must increase substantially if we want a internationally leading European plant-based bioeconomy. This strategy will allow a better use of existing resources and provide incentives to increase support directed to innovative and competitive plant research that is essential for Europe's future.

As President of EPSO and on behalf of all European plant scientists, I encourage all stakeholders, regional, national and European bodies to work with European Technology Platform 'Plants for the Future' towards a strong, competitive and internationally leading European knowledge based bio-economy.

As Commission Potocnik said last week in the meeting of all European Technology Platforms: "Only European teams competed in the last rounds of the soccer World Cup championship 2006 – this is what we should go for in research as well".