STATEMENT

European Plant Science Organisation
www.epsoweb.org

New Technologies in Agriculture

15.6.2012

Agriculture has always been dependent on the incorporation of new technologies often inspired by necessity. From the earliest beginnings, plant and animal domestication was based on the identification of species and varieties that can be cultivated and that have properties of interest for the production of food and other products. It required sharp observational skills and thoughtful process of selection of seeds carrying the traits that are appropriate for the cultivation of the species which eventually became our crops. In parallel, the development of agriculture led to the identification and application of a well-developed set of agronomic rules and practices. Every step in agricultural techniques such as ploughing or irrigation practices or more recently, precision agriculture, gave rise to more efficient cultivation with benefits in plant production and its diverse applications.

During the centuries, agriculture continued being the object of study for some of the brightest minds of the time. Mendel for example defined the laws of genetics, Lawes and Gilbert developed the first inorganic fertilizers, while Jethro Tull created the first seeding machines for field use. In the middle of the 20th century, a number of different technologies have had a significant impact on agricultural production. Some of them showed the power of genetic hybrids which allowed us to develop new plant varieties and animal breeds that produced food more efficiently and of better quality. Other techniques based on innovation in chemistry gave rise to the production of fertilizers and phytoprotectants. Mechanical tools and tractors greatly facilitated the work of farmers and finally many agronomic approaches were developed to allow the best use of resources. All this progress could only happen through interdisciplinary effort bringing advancements of basic sciences and technology into good agronomic practices.

Today, plant biology is reaching a high degree of sophistication and provides a very valuable source for Innovation. Molecular techniques are producing a deluge of data which allow us to understand the genetic basis of the traits of cultivated plant species. This helps us to explain the amazing variability in plants and animals at the level of genes and genomes as well as proteins and metabolites. Increasingly integrated approaches with physiological and developmental routes are now being developed. In this way, we may more precisely define the genetic basis for the traits needed by the farmers. Methods have been developed to increase and use the variability of crop species even when complex collections of characters are involved. These include new methods that modify the genomes in a more defined way than ever before in the history of breeding.

Analysis of the interaction of the plant genetics and the environment increasingly includes image analysis to study plant function from the cellular to the whole plant and even the stand level. These phenotyping technologies support on the one hand the breeding process allowing for high throughput selection as well as enhancing our mechanistic understanding of traits and their background Furthermore these methods bridge provide innovations in precision agriculture, farming technologies using remote sensing and positioning to inform farmers on the state of plant stands in the field. To deal with these complex data and their interrelations, informatics tools are being developed that will foster the integration of genetic improvement and management practice in the future.

The following table provides an overview of the new methods that are available and the type of effects that can be expected on agriculture is presented. Some of the technologies are based on molecular methods and they already have an impact in plant breeding, both for the production of genetically modified varieties and for the extensive use of marker-assisted selection. Some of the technologies allow better phenotyping of the plants from cellular to whole plant and stand responses. They may therefore be of use in designing crops for specific purposes and will be of great help for managing the crop. These new tools will find applications specific for each crop and for defined use in the increasingly diverse portfolio of plant products as food/ feed, fibres/ chemicals and as a basis of bioenergy.

	Gene	**Protein/ Enzyme**	**Metabolism**	**Cell**	**Plant**	**Stand/ production level**
Application	Food – Feed – Fibres - Fules					
Concept	Nutrigenomics Metagenomics Biocatalysis Synthetic biology					
Technologies						
Engineering	Tilling Zinc finger Meganucleases Keytrait[R] GMO	Enzyme engineering Directed evolution Model-based engineering of biocatalyis	Metabolic engineering		Horticulture Precision plant management	Precision agriculture Farm management
Data storage and integration	Bioinformatics/ databases	Modelling-protein folding – molecular dynamics	Bioinformatics – databases, metabolic network modelling		Phenotypic databases Image analysis Structure-function models Optimization models	Integrated farm management network Ag-engineering
Data acquisition	Genotyping QTL MAS	Proteomics Structurebiology	Metabolomics biomarkers		Phenotyping (Deep, high throughput) Plant structure quantification Novel sensors	Phenotyping field Novel sensors in agricultural engineering

Table 1: Technologies and applications

Conclusions

- Many new technologies are emerging that are already having an impact in different disciplines related to agriculture
- These technologies may be important for the breeding of plants with many different characters and they are already being used in seed industry
- The new characters available may be important to produce plants that have new uses beneficial to farmers
- Other technologies may have a direct impact upon farm management

Acknowledgements
EPSO wishes to thank Pere Puigdomènech (Institut de Biologia Molecular de Barcelona, Spain) and Maurice Moloney (Rothamsted Research, UK) for leading the development of this paper, as well as the Agricultural Technologies Working Group members for their valuable contributions.

Contacts
Pere Puigdomènech
+34-93-563-3000
pere.puigdomenech@cragenomica.es

Maurice Moloney
+44 1582763133
maurice.moloney@rothamsted.ac.uk

EPSO Office
+32-2213-6260
epso@epsomail.org

Useful links

Agricultural Technologies Working Group webpage: http://www.epsoweb.org/agricultural-technologies-wogr
Communications webpage: http://www.epsoweb.org/epso-communications
EPSO member institutes and universities: www.epsoweb.org/about/members.htm
EPSO representatives: www.epsoweb.org/about/representatives.htm

About EPSO

EPSO, the European Plant Science Organisation, is an independent academic organisation that represents more than 226 research institutes, departments and universities from 30 countries in Europe and beyond. EPSO's mission is to improve the impact and visibility of plant science in Europe. www.epsoweb.org