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EDITORIAL

The International Conference on "Heterosis in Plants"

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The commercial exploitation of heterosis or hybrid vigor through the development and cultivation of hybrid cultivars is one of the landmark achievements in plant breeding. Ever since the two pioneering publications by George H. Shull 100 years ago, in which he scientifically described heterosis and laid the foundation of modern hybrid breeding in maize, the exploitation of heterosis in crop and tree species has greatly expanded and the acreage under hybrid cultivars has steadily increased. Thus, hybrid breeding has made commendable contributions in meeting the food, feed, and fiber needs of the burgeoning population of the world, and benefitted farmers and consumers. It also promoted the development of a viable seed industry, which was a tremendous stimulus for the research in plant breeding.

The overwhelming importance of heterosis attracted many scientists to study the underlying genetic causes of this unique phenomenon. Vast data sets were generated and analyzed in different disciplines. To compile and discuss the accumulated information, two international conferences were organized in the past: The first conference was held in 1950 at Iowa State College in Ames and lasted for 4 weeks. The second conference was organized in 1997 by CIMMYT in Mexico City. Both conferences proved to be landmarks in research on heterosis and its exploitation in plant breeding.

In recent years, there have been new developments in agriculture. On one hand, intensive agriculture is adversely affecting the natural resources and the arable land available for food production is decreasing with the increasing demand of plants for industrial purposes and renewable resources of energy. On the other hand, our needs for food and feed production are increasing, because of an ever growing population and improving living standards. Further, future agriculture is expected to face serious challenges due to the impending climate changes. Consequently, serious concerns are being expressed about the food security of our planet.

A viable option to meet the increasing demands is the enhancement of productivity per unit of resources on a sustainable basis. In this scenario, optimal exploitation of heterosis can play a key role. It enables plant breeders to provide cultivars possessing high genetic potential. A better understanding of the causes underlying heterosis will facilitate the development of new breeding approaches for rapid and efficient exploitation of heterosis.

The recent advances in genomics, bioinformatics and related fields have provided researchers with novel tools and approaches to investigate heterosis. Multidisciplinary teams of scientists are working on their application to link the new results for a better understanding of heterosis at various biological levels (DNA, mRNA, proteins and metabolites). These advances have expanded the disciplinary domain and knowledge at a rapid pace. Therefore, the University of Hohenheim considered it appropriate to organize and host a third international conference on "Heterosis in Plants" in Stuttgart, Germany, from 7 to 9 September 2009.

The main aims of the conference were (1) to summarize the progress in theory and experimental studies on heterosis at different biological levels during the past 12 years, (2) to promote a better understanding of the biological processes underlying heterosis and (3) to stimulate further advances in the exploitation of heterosis in plant breeding by the application of new genomic tools.

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The Organizing Committee comprising eminent scientists from many nationalities and disciplines identified internationally renowned colleagues as speakers and also encouraged scientists and plant breeders worldwide to participate and share their knowledge and experiences. The fruits of the joint effort were evident from the large assembly of nearly 250 participants from 25 countries. There were 38 speakers and excellent presentations that greatly enthused the audience as was evident from the intensive discussions that followed the lectures.

The topics included genetic models, mating designs, gene expression patterns, genomic and transcriptome variation, metabolic networks, management of heterotic groups, and prediction of hybrid performance. The Conference was a big leap forward in integrating theoretical advances and experimental results from various disciplines for better understanding the molecular and genetic bases of heterosis and promoting its utilization in a wider range of species.

The Organizing Committee is deeply indebted to all speakers and expresses gratitude to all delegates. The Committee also gratefully acknowledges the generous financial support received from the German Research Foundation (Deutsche Forschungsgemeinschaft, DFG), numerous sponsors from the private sector and the German Society for Plant Breeding. Without this encouragement and help, it may not have been possible to organize this conference.

To make the results of this successful conference available to a larger public, we decided to publish them as a special issue on "Heterosis in Plants" in *Theoretical and Applied Genetics*. Most of the speakers accepted our invitation to contribute to this special volume. Owing to the rapid developments in heterosis research, we decided to publish this volume immediately after the conference. This put a lot of pressure on the authors, reviewers, members of the editorial board and especially the two managing editors, Drs. Eva Bauer and Jochen Reif. The Committee is indebted to all of them for their cooperation. We sincerely hope that this special volume will be a useful and informative resource to researchers, practitioners and students of genetics and plant breeding.

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