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Muhammad Asif

Progress and Opportunities of Doubled Haploid Production

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Foreword

The importance of haploidy or single totipotent cell to form a haploid plant is well known to plant scientists in the field of agriculture and related disciplines. The work on haploidy started in 1921 by A. D. Bergner who reported this fascinating phenomenon in *Datura stramonium* L. Since then, numerous findings have been reported in various crop species and the efforts to improve doubled haploid production resulted in the discovery of various methods like anther culture, isolated microspore culture, and wide hybridization. In crop plants, the ability to produce identical/homozygous individuals from single cells has dramatically reduced timescale to develop new cultivars and doubled haploidy has now become an essential biotechnology tool in plant breeding programs. The single cell-culture system provides many opportunities for process improvement, and genetically identical and physiologically uniform single cells are also being used as targets for cell biology, embryology, and genetic engineering studies.

On planning this monograph, my intent was to discuss the importance of haploidy in a variety of areas from fundamental to applied research and how molecular methods have been exploited recently to unravel/explore some of the underlying aspects of this fascinating developmental phenomenon of doubled haploids. Consequently, the brief is divided into six chapters. The introductory chapter (Chap. 1) provides information to the readers regarding history, production methods, and types of haploids. The next three chapters (2, 3, and 4) highlight various steps involved in the production of doubled haploids via androgenesis, gynogenesis, and parthenogenesis. The major bottlenecks of doubled haploid production like low frequency of green plant production and albinism have been discussed in detail along with major achievements that have changed the status of many recalcitrant crop species to responsive over the last 90 years. The use of doubled haploidy in plant breeding program is an effective strategy to achieve homozygosity in one generation and doubled haploid populations are being used extensively to map quantitative trait loci/genes of interest. Unicellular microspores and haploid embryos are main targets of mutation breeding and genetic transformation studies, as discussed in Chap. 5. Chapter 6 summarizes the brief along with future prospects of doubled haploid production.

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