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Book Review

Plant Biotechnology I, Tissue Culture and Its Applications (Editors: M. Babaoglu, E. Gurel, S. Ozcan), Selcuk University Foundation Publications, Konya, Turkey, 374 p.

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Towards the end of the last century, we witnessed amazing developments in the biological sciences that revolutionized our thinking about nature. These developments are already becoming widely applicable to a number of areas such as human health, the environment, plant and animal breeding and many more areas. One of the significant consequences of these developments was the application of these technologies to agriculture. Over the last few decades, agricultural biotechnology has emerged as a promising technology that has a great potential to meet the demand for food in the 21st century. This is quite important because, according to some estimates, the world's population is expected to double by the year 2050 and 90% of the whole population is expected to reside in developing countries. I am not very pessimistic but this reminds me that we might soon be facing new challenges in providing food (not to mention the quality of it) for everyone. Food production will have to be doubled or preferably tripled in the next 50 years to meet the demand. This challenge is significantly increased by the declining availability of water available for crop production. Therefore, additional increase in production will have to be on existing agricultural land or in regions considered as marginal land if we want to keep the precious forest, untouched. This basically requires that a substantial increase in agricultural productivity be achieved.

There are numerous ways to increase the agricultural productivity in a sustainable way. Some of these may include the use of biological fertilizers, improved control of pests and pathogens, soil and water conservation and the use of improved plant varieties. In addition, we cannot underestimate the importance of social and political reforms that might lead to a more homogeneous distribution of food and other resources between developed and the developing regions of the world. Nevertheless, of these measures, biotechnological applications probably hold the most promise in increasing the agricultural productivity when properly integrated into traditional farming systems. It is in the developing world that agricultural biotechnology could have its major impact in increasing crop production. Ironically, however, most developing countries do not have sufficient resources to apply biotechnology to solve the major problems limiting agricultural productivity. Competent use of these technologies would obviously require trained human resources.

To serve this purpose, formal education in biotechnology has recently been incorporated into the curriculum of most universities in Turkey. However, lack of literature in Turkish (literature written in English is also scarce and perhaps not very useful as students are often not proficient in English) has seriously hampered the uniformity and effectiveness of these efforts. The editors of the recently published book "Plant Biotechnology I, Plant Tissue Culture and its Applications", therefore, aimed at producing a written text that mainly serves as a reference for educational purposes. In my opinion, the publication of this book is significant for several reasons. First of all, to the best of my knowledge, this is the first comprehensive book published in Turkish which deals specifically with plant biotechnology and its applications. Secondly, similar to its counterparts published in other languages, each chapter has been written by a team of authors who are also experienced researchers in their respective areas. And thirdly, the printing of the book has been very professionally done and meets the strictest international standards. This is something that we are not very used to seeing in many other technical books written in Turkish. Yet the book is very reasonably priced. Although the primary aim of this book is to provide information about plant tissue culture processes, actual methodology on tissue culture laboratory techniques has also been given in

sufficient detail. The balance between basic aspects and practical application of tissue culture technologies has been well maintained throughout the book. Therefore, this book, in my opinion, also has utility as a laboratory manual for the introductory plant tissue culture classes at both graduate and undergraduate levels.

The first chapter of the book presents a historical perspective of the tissue culture technology and introduces the main techniques being used in plant tissue culture. Information included in this chapter, such as preparing a basic tissue culture media, and sterilization methods, can be particularly useful for beginners. This first chapter is followed by other chapters which not only introduce the readers to the basic concepts of in vitro plant regeneration but also provide a number of examples about their practical applications. For instance, exploitation of mechanisms by which individual cells grow and regenerate into differentiated tissue, organs and eventually the whole plant is the basic process underpinning almost all tissue culture processes. Different mechanisms such as organogenesis or embryogenesis can potentially give rise to a whole plant under certain conditions, mostly defined by the hormonal composition of the culture media. Chapters 2 and 3 deal with these basic processes. We should also remember that the application of tissue culture techniques is by no means limited to regenerating whole plants from single cells. As extensively discussed in Chapter 10, plants can also be regenerated in vitro from mature or immature embryos. Embryo culture is resorted to when embryos resulting from normal pollination/fertilization events need to be grown in vitro before they become capable of germinating normally. Culturing immature embryos soon after fertilization (embryo rescue) is often the only way to obtain viable plants from hybridizations between relatively distant species. In certain plant species, cultured embryos are also used as an explant for gene transfer using certain technologies (see the second volume of this book).

As mentioned above, plant regeneration from cultured cells requires exposure to somewhat artificial conditions such as high concentrations of auxin and cytokinin. These drastic conditions, when coupled with in vitro environmental conditions, may cause certain changes in the genetic composition of the regenerated plants. Although such genetic changes are mostly detrimental, the resulting genetic variation can be exploited for the benefit of increasing variation which is an asset in classical plant breeding. In Chapter 11 of the biotechnology book, both potential sources of such variation and potential difficulties that may arise when exploiting such variation for breeding purposes are discussed in detail.

Chapter 4 of this book is dedicated to protoplast culture and somatic hybridization techniques. Plant breeding efforts to combine certain parts of the two somewhat genetically different genomes cannot be possible if the species to be improved are not compatible sexually. The technology termed somatic hybridization facilitates the exchange of genetic information between otherwise incompatible species and has been invented to overcome inherent limitations of traditional plant breeding. Another useful application of plant tissue culture technology is the production of dihaploid (doubled haploid) plants generated following the doubling of the chromosomes of the original regenerant. For certain species, this can be achieved with relative ease using technologies (e.g. culturing of pollen grains) that are explained in detail in Chapter 5. Chapter 7 of the book deals with culturing plant cells for the purpose of large-scale extraction of useful compounds that could not otherwise be economically obtained. Plant cells grown in the culture secrete into the medium complex compounds called secondary metabolites. Upon purification, such compounds can be used for many industrial processes as exemplified in detail in this chapter.

Micropropagation techniques such as shoot tip/meristem cultures are being widely used in obtaining pathogen-free clones required for the distribution of the plant material for commercial purposes. No doubt the information presented in Chapter 6 along with that given in Chapter 8 (micropropagation) will be useful in guiding practical applications. Preservation of valuable germplasm is undoubtedly another important issue facing plant breeders, as the genetic relatedness of the current crop varieties is becoming higher than ever. This obviously requires preservation of plant genetic resources for their potential use in the future. Plant tissue culture methods are being extensively used in this area as exemplified in Chapter 9. Chapter 9 also gives a detailed account of the technical conditions that need to be considered for successful preservation.

One of the difficulties associated with writing a technical book that is not in English arises from the fact that the authors need to identify technical words/phrases etc. that are not only sufficiently similar in meaning to the original words/phrases etc. but also phonetically correct.

This is not a trivial task. Importantly, the proposed new terminology can not become a convention unless it is also accepted and used by others. I feel that although the authors have had some difficulty in identifying the self-explanatory scientific terminology in Turkish, to my surprise, most of the time they came up with terminology that is sufficiently similar to corresponding terminology used in English. The use of similar terms to refer to identical concepts has been relatively well managed through the book and the credit for this goes to the Editors. In addition, a glossary, which contains definitions of certain technical terms, has also been included. Obviously, this is a very useful effort but unfortunately the content of the glossary is not sufficient. Nevertheless, I would absolutely commend these efforts especially when considering the fact that the purpose of this book is not simply to produce a dictionary of tissue culture terms but is indeed much broader than this.

In conclusion, I consider the first volume of this book a successful example of its kind. I am quite confident that the book will be extensively used as a reference for both graduate and undergraduate teaching in agriculture and botany as well as a useful guide in setting up actual tissue culture experiments or industrial applications. After reading the book thoroughly, the only thing that I felt was missing, was a section on the genetic engineering of plants, which historically has emerged on the strong foundation prescribed by the advances in plant tissue culture technology. It is, however, pleasing to know that the second volume of the book dealing solely with plant genetic engineering will soon be published. The first volume of the Plant Biotechnology book certainly prepares the reader to its upcoming second part -- Plant Biotechnology II, Plant Genetic Engineering. I expect that the second volume of this book will be at least as comprehensive as the first volume and again exceed most expectations by achieving new standards in technical publishing.