PREFACE

I vividly recall having a series of conversations back in the mid-1990s with "older" plant biotechnologists. These were the seasoned veterans who'd been on the cutting edge of figuring out how to make transgenic plants and how they might partially solve some critical problems in agriculture. They had been through the long days, weeks, months, and years of making genetically engineered commercial crops a reality as the middle of that decade saw the first commercial products hit the market. These scientists had worked out the basic science on how to produce recombinant DNA; genetically engineer the novel DNA sequences into plant cells; and then recover, for the first time, genetically engineered crops. They had witnessed challenge after challenge in the lab. They'd plodded through failures—many failures—and then, finally, success! After the promising transgenic crop lines had been produced, then came the arduous process of plant breeding, which was needed to move the useful traits into agronomic varieties that farmers would want to grow. Then came the field testing, seed production, and then…let's not forget about all the regulatory approvals. Each step was like those taken by a toddler. It was all new ground. The difference between walking and falling down was measured in millimeters. And the baby put one foot in front of the other, often with great pauses to regain balance. Finally, the faithful day would arrive when the genetically engineered seed would be planted and bear fruit in farmers' fields. And there we were.

It wasn't a shock in the mid-1990s when these scientists expressed to me their feelings that went something like, "all the really fun stuff has already been done." I was still a pretty young scientist at the time, and so who was I to question their insights? These insights from giants who stood on the shoulders of giants? So, in these awestruck moments, I asked polite questions, listened to their stories, and like a fawning fan I would muster an occasional "cool!" To be honest, their words and attitudes took a little wind out of my sails after I went back to my own little lab and office. From their perspective, indeed, the big challenges of moving those first molecules from idea to seed could never be matched again. But still, I thought about the future of the field and plodded along with my own ideas and research. I wanted to make the world a better place and believed that we could innovate with plant biotechnology—even, maybe, despite the assertion that all the coolest and most fun stuff had already been done. So I thought.

When we fast-forward about 10 years later, I thought it would be a fun project to put together a plant biotech textbook to support the course I'd offered to teach. The product of all the fun would be what became the first edition of the title in your hands. As that book came together, I sometimes thought about what I'd been told by these sages. The content of the text in the book, it seemed, mostly consisted of the tried and true technologies that were used in making those first engineered plants. There were also stories told of the glory days by scientists who penned their "Life boxes" in the book. After a while, however, I noticed that the first edition was starting to be somewhat dated itself. There were now new DNA sequencing technologies. There were new analytical techniques. New genome editing tools and synthetic biology tools had been invented and it was clear they would have an impact on plants. Computers had also changed what could be done and the speed tasks could be performed. So I embarked on updating the book and the second edition took shape.

Sometime in the last year or so, while working on the book, it really started to hit me, and has since pounded me like a John Henry sledgehammer on railroad spikes: those good old days were not the best days of plant biotechnology after all. The best and most fun stuff has not been done yet

Yes, of course, a baby only learns to walk once, but now plant biotechnologists could sprint. It became clear that genome editing tools could allow biotechnologists to reconfigure existing genes in plants in ways never imagined by the early pioneers of biotechnology. Recently, a chromosome has been totally synthesized and installed into yeast—how long would it be before whole new entire pathways could be installed into plants to enable them to do things not even thought possible in the good old days? I have become convinced that the most intriguing and exciting days in plant biology and biotechnology are to be ushered in as computationally enabled genetics matures and becomes widely utilized. Crop productivity will continue to be improved using new innovations. Increased yield will feed more people with more nutritious food. And the readers of this book will be the ones to usher in the next wave of innovation. That is best and most fun part for me right now—making the future reality.

The second edition contains all updated chapters and new chapters in systems and synthetic biology. The "Life box" profiles of the plant biologists and biotechnologists who have made a difference in the field have been updated and the number of scientists who are profiled has been expanded. The lecture slides for open access to instructors and students remain at http://plantsciences.utk.edu/pbg/, and these are updated each time I teach the class. Feel free to offer any suggestions or slides of your own that I could use to update this resource.

I'm very grateful to the chapter authors and Life Box authors—both carried over from the first edition of the book—and the new ones. Thanks to my lab crew for their patience during the preparation of the book. I'm particularly indebted to Jennifer Hinds at the University of Tennessee. Jennifer did so much work on the book, I can't begin make a list of her contributions. This much is certain: without Jennifer, there would be no second edition of the book. Thanks, Jennifer! You're awesome!!

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