

Engineered Plant Minichromosome and Its Application in Genomics and Genetic Engineering

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Engineered minichromosomes have been constructed as novel artificial chromosome platforms for future genetic engineering in maize. We demonstrated that minichromosomes could be created by telomere-mediated chromosomal truncation of both normal A chromosomes and the supernumerary B chromosomes of maize, the minichromosomes were stable during both mitosis and meiosis, transgenes were expressed from minichromosomes, and we also demonstrated the proof of concept that minichromosomes could accept new genetic elements by a site-specific recombination system. The engineered minichromosome technology opens new avenue for future genetic engineering in the following areas. First, minichromosomes are ideal for gene stacking. Conventional genetic engineering has limitations in stacking multiple genes because of the segregation of unlinked genes, and is also limited by linkage drag where undesired genes closely linked to the transgene are difficult to get rid of during genetic crosses. Second, engineered minichromosomes can be used as super vectors to express complex gene traits to confer new properties. Advantageous new properties would include those that would reduce, eliminate or manipulate the use of chemical fertilizers and herbicides, provide insect or microbial resistance, allow adaptation to new environments, improve cultivation techniques, increase yield or facilitate the development of biofuels. Engineered and artificial chromosome technology will also allow the use of plants as factories to generate multiple protein or metabolic products more inexpensively than by other methods. Third, the telomere truncation technology, which was used for engineered chromosome construction, can be used for chromosome engineering. Chromosomes can be systematically truncated to find out essential elements for chromosomal behavior. Telomere truncation and engineered minichromosome technologies should be applicable to other plant species. We previously demonstrated that multiple copies of cloned *Arabidopsis* telomere sequences (TTTAGGG) can break chromosomes in maize when integrated into the genome. Telomere sequences are conserved in higher plants. We hope to extend this technology to cotton, rice, wheat, soybean, brassica, etc. for the genomics and genetic engineering of these crops.