Genome-wide Physical Mapping with Large-insert Bacterial Clones: the BAC Physical Maps of the Rice and *Arabidopsis Thaliana* Genomes

大片段插入细菌克隆的基因组水平物理作图 水稻和拟南芥基因组的BAC物理图谱

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Biological sciences have entered the genome era. "Changes that will have effects comparable to those of the Industrial Revolution and the Computer-based Revolution are now beginning. The next great era, a genomics revolution, is in an early phase" (*Science*, Vol. 279 p2019, 1998). The next wave in the genome research will hinge on the development of genomewide physical maps. A genome physical map is typically achieved by reconstruction of the genome from DNA fragments permanently maintained in an ordered DNA library. A physical man will provide a platform for structural, functional and evolutionary genomics research and pave a "freeway" for large-scale gene discovery, cloning and utilization.

To rapidly develop physical maps of genomes with large-insert bacterial clones, we developed a set of techniques for physical mapping of genomes, by which a physical map of an organism with a genome size of 1000 Mb can be developed by three scientist years at a cost similar to that for a moderate density RFLP map. We also experimentally tested the feasibility and developed the strategies of genome-wide physical mapping with large-insert bacterial clones. Using these strategies and techniques, we have successfully developed a genome-wide, sequenceready physical map of the rice genome from three complementary BAC libraries by 1.5 scientist years and a genome-wide, sequence-ready and large-scale transformation-ready physical map of the *Arabidopsis thaliana* genome from three complementary large-insert BAC and BIBAC libraries by 0.5 scientist year.

The rice physical map consists of 298 contigs, covering 97.4% of the rice genome. The Arabidopsis physical map consists of 44 BAC and BIBAC contigs, covering 91% of the Arabidopsis genome. Extensive analysis of the physical map contigs indicated that the physical maps of both genomes are highly reliable, and thus will greatly facilitate structural, functional and evolutionary genomics research of plant species (see our web site at http://hbz.tamu.edu). This study has demonstrated that genome-wide physical mapping by fingerprint analysis is not significantly influenced by repeated DNA sequences, genome size and genome complexity. Use of complementary libraries developed with different restriction enzymes is a powerful and efficient approach to minimize the "gaps" in the physical maps. The number of clones having 6.0～8.0 x genome coverage is sufficient for development of a genome-wide physical map of >95% genome coverage. The DNA sequencing gel-based fingerprint analysis is a reliable approach for genomewide physical mapping with large-insert bacterial clones.

This study has provided a paradigm for rapid

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动物生物技术——从试管婴儿到转基因动物到克隆

Animal Biotechnology: From Test-Tube Baby to Transgenic Animals and Clones

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近50年的动物生物技术,特别是生殖生物技术的研究使畜牧业生产及育种发生了革命性变化。近20年来的试管婴儿、转基因动物及克隆技术的研究,乃使农业与医学研究的界限无法划分。试管婴儿技术不仅使成千上万的不育夫妇获得子女,更为动物育种、国际种质交流开辟了新途径。转基因技术对生物抗病高效育种及人类基因治疗具有重要意义。但由于经费投入所限,转基因动物技术在农业上的应用进展缓慢。相反,由于工业界、医药界的卷入及大量投资,转基因技术在动物制药(生物反应器)及异种器官移植方面,近年来有了突飞猛进的进展。克隆技术虽然从40年代起即开始研究,但直到1997年"多利"的问世,该技术才引起人们的高度重视。"多利"是采用怀孕母羊的乳腺细胞克隆而成,是世界上第一个用成年动物细胞克隆成功的。之后,日本和新西兰科学家又用牛卵巢及输卵管细胞克隆成功。最近本试验室用一老年牛(13岁)皮肤细胞克隆成功。这是世界上第一次用与生殖系统无关的成年细胞进行成功克隆的报导,对研究动物及人类的遗传、基因活化以及衰老长寿等均具有重要意义。

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development of genome-wide physical maps of different plant and animal species from large-insert bacterial clones. For almost all of the important plant and animal species no genome-wide physical maps are currently available. Based on the results of this research, the genome-wide physical maps of the following species could be developed by our current techniques from large-insert bacterial clone libraries:

Soybean	1100 Mb/1C	2.6 SYs
Cotton	2200 Mb/1C	5.1 SYs
Maize	2500 Mb/1C	5.8 SYs
Wheat D genome	4000 Mb/1C	9.3 SYs
Barley	4900 Mb/1C	11.4 SYs
Cucumber	370Mb/1C	0.8 SYs
Chinese Cabbage	600 Mb/1C	1.4 SYs
Tomato	950 Mb/1C	3.2 SYs
Peach	260 Mb/1C	0.6 SY
Orange	380 Mb/1C	0.8 SY
Grape	480 Mb/1C	1.1 SYs
Pear	500 Mb/1C	1.2 SYs
Apple	760 Mb/1C	1.8 SYs
Chicken	1100Mb/1C	2.6 SYs
Human	3000 Mb/1C	7.0 SYs

* SYs: scientist years