

植物诱变育种 · 农业生物技术

11种植物 $psbA$ 基因的密码子偏好性及聚类分析

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摘要:

植物叶绿体  $psbA$  基因的启动子是叶绿体基因工程中常用的启动子, 研究该基因的编码特点对完善叶绿体基因工程的研究设计、提高外源基因在受体物种中高效、稳定的表达具有重要作用。本研究综合运用了多种分析软件, 对11种植物的叶绿体  $psbA$  基因进行了分析。结果表明, 11种植物  $psbA$  基因的ENC(Effective Number of Codons) 值都小于40, 显示出了明显的密码子偏好性, 即在碱基组成上偏爱以C结尾的密码子。RSCU(Relative Synonymous Codon Usage) 值表明共有20个密码子在编码使用上具有偏好性, 其中有8个表现出较强的偏好性; 另有12个密码子在  $psbA$  中出现率极低或没有出现。在聚类分析中, 基于密码子偏好性参数RSCU的聚类不能正确反映物种间的进化关系, 而基于基因序列的聚类更适合作为系统发育分析的参考。

关键词:  $psbA$  基因 密码子偏好性 聚类分析

CLUSTER ANALYSIS AND CODON USAGE BIAS STUDIES ON  $psbA$  GENES FROM 11 PLANT SPECIES

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Abstract:

The promoter of  $psbA$  gene was frequently used in genetic engineering as the promoter expressed in the chloroplast. Characterization of the codons usage of  $psbA$  genes is important to the perfect investigations of genetic engineering in chloroplast. In this study, codon usages of  $psbA$  genes from 11 plant species were analyzed by several softwares. The results showed that all the effective number of codons (ENC) were less than 40 in 11 plant species, suggesting that codon usage bias existed in the  $psbA$  genes. For example, The codons ending with C were frequently used. Relative synonymous codon usage analyses showed that 20 codons were preferable in the codons of coding DNA sequences (CDS) of  $psbA$  gene, whereas 12 codons were seldom used. The cluster tree based on the relative synonymous codon usage (RSCU) could not reveal the evolutionary relations among the 11 plant species, whereas that based on CDS of  $psbA$  gene could reveal their evolutionary relationship much better.

Keywords:  $psbA$  genes codon usage bias cluster analysis

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参考文献:

[1] Daniell H, Khan M, Allison L. Milestones in chloroplast genetic engineering: an environmentally friendly era in biotechnology [J]. Trends Plant Sci, 2002, 7(2): 84-91

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[2] Boynton J E, Gillham N W, Harris E H, Hosler J P, Johnson A M, Jones A R, Randolph-Anderson B L, Robertson D, Klein T M, Shark K B, Sanford J C. Chloroplast transformation in chlamydomonas with high velocity microprojectiles [J]. Science, 1988, 240: 1534-1538

[3] Svab Z, Hajdukiewicz P, Maliga P. Stable transformation of plastids in higher plants [J]. Proc Natl Acad Sci USA, 1990, 87(21): 8526-8530

[4] Hou B K, Zhou Y H, Wan L H, Zhang L Z, Shen G F, Chen Z H, Hu Z M. Chloroplast transformation in oilseed rape [J]. Transgenic Res, 2003, 12 (1): 111-114

[5] Zhang X H, Portis A R Jr, Wildholm J M. Plastid transformation of soybean suspension cultures [J]. J Plant Biotechnol, 2001, 3: 39-44

[6] Sikdar S R, Serino G, Chaudhuri S, Pal M. Plastid transformation in Arabidopsis thaliana [J]. Plant Cell Rep, 1998, 18 (1): 20-24

[7] Kumar S, Dhingra A, Daniell H. Stable transformation of the cotton plastid genome and maternal inheritance of transgenes [J]. Plant Mol Biol, 2004, 56 (2): 203-216

[8] Ellis R J. Chloroplast proteins: synthesis, transport, and assembly [J]. Annu Rev Plant Physiol, 1981, 32: 111-137

[9] Wu N H, Cote C J. Structure of the chloroplast *psbA* gene encoding the Q<sub>B</sub> protein from *Oryza sativa* [J]. Develop Genet, 1987, 8: 339-350

[10] 吴乃虎, 方晓华, 施晓梅, 张晓武, 周立, 黄美娟, 孙凯鸣. 高粱叶绿体 *psbA* 基因的结构特征及其5'-非编码区的调控效应 [J]. 中国科学C辑, 1999, 29(4): 397-406

[11] Zeidner G, Preston C M, DeLong E F, Massana R, Post A F, Scanlan D L, Béjà O. Molecular diversity among marine picophytoplankton as revealed by *psbA* analyses [J]. Environ Microbio, 2003 (5): 212-216

[12] 吴晓微, 孙雪, 陆开形, 汪一冰, 张晓龙. 小球藻 *psbA* 基因的克隆与序列分析 [J]. 水产科学, 2008, 27(7): 360-362

[13] 袁进成, 刘颖慧. 基于叶绿体 *psbA* 基因初步探讨植物系统发育的关系 [J]. 江苏农业科学, 2009, 4: 46-49

[14] Wright F. The "effective number of codons" used in a gene [J]. Gene, 1990, 87(1): 23-29

[15] Sharp P M, Li W H. An evolutionary perspective on synonymous codon usage in unicellular organisms [J]. J Mol Evol, 1986, 24: 28-38

[16] 刘汉梅, 赵耀, 顾勇, 张怀渝, 黄玉碧. 几种植物 *waxy* 基因的密码子用法特性分析 [J]. 核农学报, 2010, 24(3): 476-481

[17] 刘汉梅, 何瑞, 赵耀, 张怀渝, 黄玉碧. 玉米密码子用法分析 [J]. 核农学报, 2008, 22(2): 141-147

[18] 周晓明, 赵慧芳, 陆嘉良, 潘浩, 徐眉, 赵根明, 姜庆五, 汪华, 俞顺章. 甲型流感病毒基因变异与生存选择压力相关性分析 [J]. 中华传染病杂志, 2005, 23 (4): 221-223

[19] Wong G K S, Wang J, Tao L, Tan J, Zhang J G, Douglas A P, Yu J. Compositional gradients in gramineae genes [J]. Genome Res, 2002, 12: 851-856

[20] Hélène C, Frédérique L, Michel C, Alain H. Codon usage and gene function are related in sequences of *Arabidopsis thaliana* [J]. Gene, 1998, 209: GC1-GC38

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1. 傅旭军, 朱申龙, 袁凤杰, 朱丹华, 董德坤, 汪自强. 浙江省和其他省份大豆种质资源的遗传多样性分析[J]. 核农学报, 2009, 23(5): 747-751
2. 贾银锁, 张锦熙, 刘钰山. 冬小麦不同单位根的功能及分组的研究[J]. 核农学报, 1990, 4(01): 25-30
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5. 丁明忠, 潘光堂, 张中华, 杨燕, 李立安. 用ISSR分析四川苎麻品种(系)间的遗传关系及雄性不育分子标记的建立

[J]. 核农学报, 2008,22(02): 183-187

6. 褚盼盼; 向长萍; 张称心; 刘成平; .中国南瓜种质资源农艺性状与RAPD标记分析[J]. 核农学报, 2007,21(05): 441-446

7. 蔡健; 兰伟; 李飞天; 罗瑞丽; 闻峰; .利用AFLP标记和形态性状检测皖北小麦主栽品种的遗传多样性[J]. 核农学报, 2007,21(02): 116-119

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