

本期目录 | 下期目录 | 过刊浏览 | 高级检索

[打印本页] [关闭]

## 论文

### 转甜菜碱醛脱氢酶基因马铃薯的抗旱耐盐性

张宁<sup>12</sup>, 司怀军<sup>12</sup>, 栗亮<sup>1</sup>, 杨涛<sup>12</sup>, 张春风<sup>1</sup>, 王蒂<sup>1\*</sup>

1甘肃省作物遗传改良与种质创新重点实验室, 甘肃兰州730070; 2甘肃农业大学生命科学技术学院, 甘肃兰州730070

摘要:

通过根癌农杆菌介导法将甜菜碱醛脱氢酶(BADH)基因导入马铃薯栽培品种甘农薯2号, 经PCR、Southern杂交和Northern杂交证明*BADH*基因已整合到马铃薯基因组中并在转基因植株中转录和表达。测定表明对照植株没有BADH酶活性, 各转化株系在胁迫前后BADH酶活性近似, 在2~11 U之间。BADH酶活性与叶片的相对电导率呈一定的负相关( $y = -3.7738x + 57.083$ ,  $r = 0.989^{**}$ )。在NaCl和PEG胁迫下, 转基因植株生长正常, 株高比对照提高0.41~1.00 cm, 单株重量比对照增加10%~35%, 说明外源*BADH*基因的导入提高了马铃薯植株对干旱和盐碱的抗性。

关键词: 马铃薯 甜菜碱醛脱氢酶 遗传转化 抗旱 耐盐

### Drought and Salinity Tolerance in Transgenic Potato Expressing the Betaine Aldehyde Dehydrogenase Gene

1Gansu Key Laboratory of Crop Genetic & Germplasm enhancement, Gansu Agricultural University, Lanzhou 730070, China; 2College of Life Science and Technology, Gansu Agricultural University, Lanzhou 730070, China

1Gansu Key Laboratory of Crop Genetic & Germplasm enhancement, Gansu Agricultural University, Lanzhou 730070, China; 2College of Life Science and Technology, Gansu Agricultural University, Lanzhou 730070, China

Abstract:

Glycine betaine (GB) is a common compatible solute in many different organisms including higher plants. Many plant species can accumulate GB in response to drought and salinity. GB is synthesized by conversion of choline to GB through a two-step oxidation via the intermediate betaine aldehyde. In higher plants, the relevant enzymes are choline monooxygenase (CMO) and betaine aldehyde dehydrogenase (BADH). The fact that many important crops, such as rice, potato and tomato, are betaine-deficient has inevitably led to the proposal that it might be possible to increase drought and salinity tolerances by genetic engineering of GB synthesis. In the present study, the transgenic plants of potato cultivar Gannongshu 2 were obtained by *Agrobacterium*-mediated transformation of the expression vector pBIBB contained *BADH* gene under the control of the constitutive promoter CaMV 35S. PCR, Southern and Northern blot analyses showed that the *BADH* gene was integrated into potato genome, transcribed and expressed in the transgenic plants. The analysis of BADH activity of transgenic plant leaves revealed that the BADH activity ranged from 2 to 11 U, while it was not detectable in the control plants. There was a negative relationship ( $y = -3.7738x + 57.083$ ,  $r = 0.989^{**}$ ) between BADH activity and relative electric conductivity of the transgenic potato leaves. The transgenic potato plants grew normally under NaCl and polyethylene glycol (PEG) stresses with increase of 0.4–0.9 cm for plant height and 17–29% for fresh weight per plant compared with the control plants. This result demonstrated that the transgenic potato plants can improve tolerances to drought and salinity as a result of transformation and expression of *BADH* gene.

Keywords: Potato Betaine aldehyde dehydrogenase Genetic transformation Drought resistance Salt tolerance

收稿日期 2008-10-29 修回日期 2009-02-13 网络版发布日期 2009-04-16

DOI: 10.3724/SP.J.1006.2009.01146

基金项目:

本研究由国家高技术研究发展计划(863计划)项目(2006AA100107), 高等学校博士学科点专项科研基金项目

扩展功能

本文信息

- ▶ Supporting info
- ▶ PDF (350KB)
- ▶ [HTML全文]
- ▶ 参考文献

服务与反馈

- ▶ 把本文推荐给朋友
- ▶ 加入我的书架
- ▶ 加入引用管理器
- ▶ 引用本文
- ▶ Email Alert
- ▶ 文章反馈
- ▶ 浏览反馈信息

本文关键词相关文章

- ▶ 马铃薯
- ▶ 甜菜碱醛脱氢酶
- ▶ 遗传转化
- ▶ 抗旱
- ▶ 耐盐

本文作者相关文章

PubMed

通讯作者: 王蒂, E-mail: wangd@gsau.edu.cn

作者简介:

---

参考文献:

- [1] Deblonde P M K, Ledent J F. Effects of moderate drought condition on green leaf number, stem height, leaf length and tuber yield of potato cultivars. *Eur J Agron*, 2001, 14: 31–41
- [2] Chen T H H, Murata N. Enhancement of tolerance of abiotic stress by metabolic engineering of betaines and other compatible solutes. *Curr Opin Plant Biol*, 2002, 5: 250–257
- [3] Rathinasabapathi B, McCue K F, Gage D A, Hanson A D. Metabolic engineering of glycine betaine synthesis: Plant betaine aldehyde dehydrogenases lacking typical transit peptides are targeted to tobacco chloroplasts where they confer betaine aldehyde resistance. *Planta*, 1994, 193: 155–162
- [4] Ishitani M, Nakamura T, Han S Y, Takabe T. Expression of the betaine aldehyde dehydrogenase gene in barley in response to osmotic stress and abscisic acid. *Plant Mol Biol*, 1995, 27: 307–315
- [5] Guo Y(郭岩), Zhang L(张莉), Xiao G(肖岗), Cao S-Y(曹守云), Gu D-M(谷冬梅), Tian W-Z(田文忠), Chen S-Y(陈受宜). Expression of betaine aldehyde dehydrogenase gene and salinity tolerance in rice transgenic plants. *Sci China(Ser.C)(中国科学·C辑)*, 1997, 27(2): 151–155 (in Chinese)
- [6] Kishitani S, Takanami T, Suzuki M, Oikawa M, Yokoi S, Ishitani M, Alvarez-Nakase A M, Takabe T, Takabe T. Compatibility of glycinebetaine in rice plants: Evaluation using transgenic rice plants with a gene for peroxisomal betaine aldehyde dehydrogenase from barley. *Plant Cell Environ*, 2000, 23: 107–114
- [7] Guo B-H(郭北海), Zhang Y-M(张艳敏), Li H-J(李洪杰), Du L-C(杜立群), Li Y-X(李银心), Zhang J-S(张劲松), Chen S-Y(陈受宜), Zhu Z-Q(朱至清). Transformation of wheat with a gene encoding for the betaine aldehyde dehydrogenase (BADH). *Acta Bot Sin (植物学报)*, 2000, 42(3): 279–283 (in Chinese with English abstract)
- [8] Li Y-X(李银心), Chang F-Q(常凤启), Du L-Q(杜立群), Guo B-H(郭北海), Li H-J(李洪杰), Zhang J-S(张劲松), Chen S-Y(陈受宜), Zhu Z-Q(朱至清). Genetic transformation of watercress with a gene encoding for betaine-aldehyde dehydrogenase (BADH). *Acta Bot Sin (植物学报)*, 2000, 42(5): 480–484 (in Chinese with English abstract)
- [9] Liu F-H(刘风华), Guo Y(郭岩), Gu D-M(谷冬梅), Xiao G(肖岗), Chen Z-H(陈正华), Chen S-Y(陈受宜). Salt tolerance of transgenic plants with BADH cDNA. *Acta Genet Sin (遗传学报)*, 1997, 24(1): 54–58 (in Chinese with English abstract)
- [10] Chen C-F(陈传芳), Li Y-W(李义文), Chen Y(陈豫), Bai J-R(白建荣), Li H(李辉), Zhu Y-F(朱银锋), Chen S-Y(陈受宜), Jia X(贾旭). Saline tolerance white clover transformed with the betaine aldehyde dehydrogenase gene by *Agrobacterium tumefaciens*. *Acta Genet Sin (遗传学报)*, 2004, 31(1): 97–101 (in Chinese with English abstract)

- [11] Luo X-L(罗晓丽), Xiao J-L(肖娟丽), Wang Z-A(王志安), Zhang A-H(张安红), Tian Y-C(田颖川), Wu J-H(吴家和). Overexpression of *Spinacia oleracea* betaine aldehyde dehydrogenase (SoBADH) gene confers the salt and cold tolerant in *Gossypium hirsutum* L. *Chin J Biotechnol* (生物工程学报), 2008, 24(8): 1464–1469 (in Chinese with English abstract)
- [12] Zhang N(张宁), Wang D(王蒂), Si H-J(司怀军). Isolation and induced expression of betaine aldehyde dehydrogenase gene from spinach. *J Agric Biotechnol* (农业生物技术学报), 2004, 12(5): 612–613 (in Chinese)
- [13] Si H-J(司怀军), Zhang N(张宁), Wang D(王蒂). Enhancement of drought and salt resistances in tobacco by transformation of betaine aldehyde dehydrogenase Gene. *Acta Agron Sin* (作物学报), 2007, 33(8): 1335–1339 (in Chinese with English abstract)
- [14] Liu J(柳俊), Xie C-H(谢从华), Huang D-E(黄大恩), Liao Y(廖勇), Wu C-J(吴承金). Research on forming mechanism of potato microtubers-effects of BA on the formation and growth of microtubers. *Chin Potato J* (马铃薯杂志), 1995, 9(1): 7–11(in Chinese with English abstract)
- [15] Si H-J(司怀军), Xie C-H(谢从华), Liu J(柳俊). An efficient protocol for *Agrobacterium*-mediated transformation of microtuber and the introduction of an antisense class I patatin gene into potato. *Acta Agron Sin* (作物学报), 2003, 29(6): 801–805(in English with Chinese abstract)
- [16] Edwards K, Johnstone C, Thompson C. A simple and rapid method for the preparation of plant genomic DNA for PCR analysis. *Nucl Acids Res*, 1991, 19: 1349
- [17] Chomczynski P, Sacchi N. Single step method of RNA isolation by acid guanidium thiocyanate-phenol-chloroform extraction. *Anal Biochem*, 1987, 162: 156–159
- [18] Bradford M M. A rapid and sensitive method for the quantitation of microgram quantities of protein utilizing the principle of protein-dye binding. *Anayti Biochem*, 1976, 72: 248–254
- [19] Li H-S(李合生). Principles and Techniques of Plant Physiological and Biochemical Experiment (植物生理生化实验原理与技术). Beijing: Higher Education Press, 2000. pp 261–263(in Chinese)
- [20] McCue K F, Hanson A D. Drought and salt tolerance: towards understanding and application. *Trends Biotechnol*, 1990, 8: 358–362
- [21] Yancey P H, Clark M E, Hand S C, Bowlus R D, Somero G N. Living with water stress: Evolution of osmolyte systems. *Science*, 1982, 217: 1214–1222

Weigle P, Weretilnyk E A, Hanson A D. Betaine aldehyde oxidation by spinach chloroplasts. *Plant Physiol*, 1986, 82: 753–759

#### 本刊中的类似文章

1. 司怀军;柳俊;谢从华.马铃薯class I patatin基因在试管块茎形成中的功能[J]. 作物学报, 2006,32(09): 1406-1409
2. 王清;黄惠英;马文芳;王蒂.反义PPO基因对马铃薯块茎褐化的影响[J]. 作物学报, 2007,33(11): 1822-1827
3. 范敏;金黎平;黄三文;谢开云;刘庆昌;屈冬玉.马铃薯*SoFtsH*基因全长cDNA克隆与在干旱条件下表达研究[J]. 作物学报, 2007,33(11): 1748-1754
4. 司怀军;王蒂.马铃薯种间体细胞杂种的育性和遗传改良[J]. 作物学报, 2003,29(02): 280-284
5. 张俊莲;王丽;王蒂;张金文;陈正华.转根瘤农杆菌介导的*AtNHX1*基因马铃薯的获得[J]. 作物学报, 2007,33(07): 1067-1072
6. 李韬;戴朝.提高马铃薯原生质体细胞分裂频率的研究[J]. 作物学报, 2000,26(06): 953-958

7. 刘晓玲;宋云枝;刘红梅;温孚江;朱常香;白庆荣.马铃薯X病毒25 kD运动蛋白基因和外壳蛋白基因介导的抗病性研究[J]. 作物学报, 2005,31(07): 827-832
8. 王清;黄惠英;陈亚兰;王蒂.转基因纯合四倍体马铃薯多酚氧化酶活性及同工酶谱的变异[J]. 作物学报, 2005,31(09): 1162-1166
9. 段艳凤, 刘杰, 卞春松, 段韶光, 徐建飞, 金黎平\*.中国88个马铃薯审定品种SSR指纹图谱构建与遗传多样性分析[J]. 作物学报, 2009,35(8): 1451-1457
10. 袁华玲;金黎平;黄三文;谢开云;李颖;屈冬玉.硫代硫酸银对二倍体马铃薯试管苗生长和生理特性的影响[J]. 作物学报, 2008,34(05): 846-850
11. 张宁;司怀军;王蒂.拟南芥rd29A基因启动子克隆及其在马铃薯抗胁迫转基因中的应用[J]. 作物学报, 2005,31(02): 159-164
12. 李军;李长辉;王巍;刘喜才;张丽娟;张文英;曹淑敏;王毅.土壤通气性对马铃薯产量的影响及其生理机制[J]. 作物学报, 2004,30(03): 279-283
13. 邸宏;陈伊里;金黎平.RAPD和AFLP标记分析中国马铃薯主要品种的遗传多样性[J]. 作物学报, 2006,32(06): 899-904
14. 郜刚;任彩虹;金黎平;谢开云;屈冬玉.马铃薯非特异性脂质转移蛋白基因StLTPa1的克隆和表达[J]. 作物学报, 2008,34(09): 1510-1517
15. 房江育;马雪泷.硅对马铃薯试管苗生长及其细胞壁形成的影响[J]. 作物学报, 2006,32(01): 152-154
16. 刘廷国;李斌;谢笔钧.转AGPase基因马铃薯淀粉溶液行为及热特性比较研究[J]. 作物学报, 2006,32(02): 310-312
17. 司怀军;谢从华;柳俊.农杆菌介导的马铃薯试管薯遗传转化体系的优化及反义class I patatin基因的导入[J]. 作物学报, 2003,29(06): 801-805
18. 李玉巧;朱鹿鸣.PP333、GA3和BA对马铃薯试管苗生长调节作用的研究[J]. 作物学报, 1994,20(01): 59-66
19. 丁玉梅;杨正安;周晓罡;张绍松;孙茂林.马铃薯质体表达载体构建及GFP基因在块茎中的瞬时表达[J]. 作物学报, 2008,34(06): 978-983
20. 郭志鸿, 王亚军, 张金文, 张玉宝, 王金牛, 谢忠奎, 陈正华.采用一种新型RNAi载体培育转基因高直链淀粉马铃薯[J]. 作物学报, 2009,35(5): 809-815
21. 王西瑶, 朱涛, 邹雪, 王吉生, 王溢.缺磷胁迫增强了马铃薯植株的耐旱能力[J]. 作物学报, 2009,35(5): 875-883
22. 徐建飞, 黄三文, 金黎平, 段韶光, 屈冬玉.马铃薯晚疫病抗性基因R17的遗传定位[J]. 作物学报, 2009,35(6): 992-997

---

文章评论 (请注意:本站实行文责自负, 请不要发表与学术无关的内容!评论内容不代表本站观点.)

HTTP Status 404 -  
/zwxb/CN/comment/listCommentInfo.jsp

---

type Status report

---

Copyright 2008 by 作物学报