

Plant hormones--- Abscisic acid (ABA) and ethylene (植物荷爾蒙-離層酸和乙烯)

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Plant hormones

- Abcisic acid (ABA, 離層酸):** seed maturation and stress-response hormone
- Gibberellins (GA, 激勃素):** regulators of plant height and seed germination
- Ethylene (C₂H₄; 乙烯):** the gaseous hormone
- Auxin (植物生長激素):** the first discovered plant growth hormone
- Cytokinins (細胞分裂素):** regulators of cell division
- Brassinosteroid (菜籽類固醇):** regulators of cell expansion and development
- Salicylic acid (SA; 水楊酸):** plant defense
- Jasmonic acid (JA; 茉莉酸):** plant defense
- Strigolactone (獨角金內酯):** shoot branching hormone
- Small peptides

Plant hormone- abscisic acid and ethylene (植物的荷爾蒙-離層酸和乙烯)

Definition of Plant Hormone (phytohormone)

Substances that influence plant growth and development at low concentration. Major classes are abscisic acid, auxin, ethylene, cytokinin, and gibberellin.

植物激素，又稱植物荷爾蒙，是一些在植物體內合成，可以從產生部位輸送至作用部位，微量濃度(nM)即可對植物體產生某種生理作用的活性有機物。植物激素能由產生部位運輸至作用部位，並調節特定細胞的細胞代謝。

Introduction

Abcisic acid (ABA): 離層酸; 脫落酸

* 1950s: **β -inhibitor complex** reported by Thomas Bennet-Clark and Ned Kefford; oat coleoptile (燕麥葉鞘)

* 1960s: **abscisin II (離層素)**, an abscission-accelerating compound (young cotton fruit).

dormin (休眠素), a dormancy-inducing factor (sycamore leaves, 楓樹)

* 1965: **abscisin II = dormin** discovered by Frederick Addicott's group in US.

Crozier et al., 2000 in Biochemistry and Molecular Biology in Plants

Introduction



Contrary to its name, ABA does not induce abscission (離層).

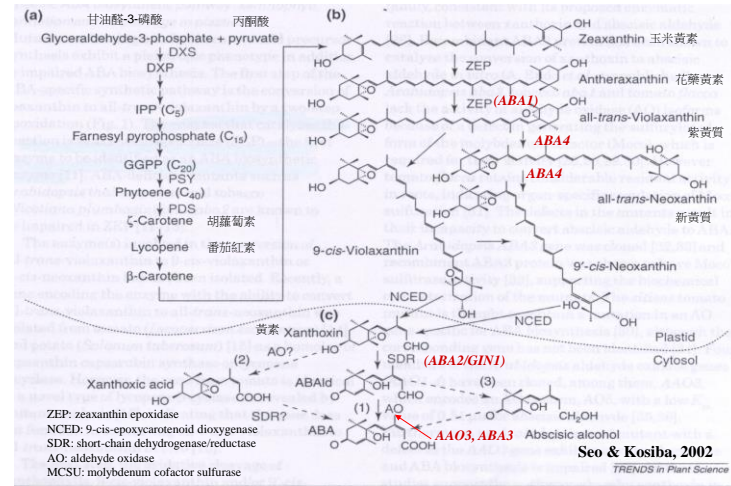
Abscission is more related to ethylene(乙烯).



vp14: ABA-deficient mutant causes viviparous(熟前萌芽) phenotype in maize.

Susuki et al., 2006; Plant J 45

ABA Biosynthetic Pathway(生成路徑)



A novel plant ABA biosynthetic route

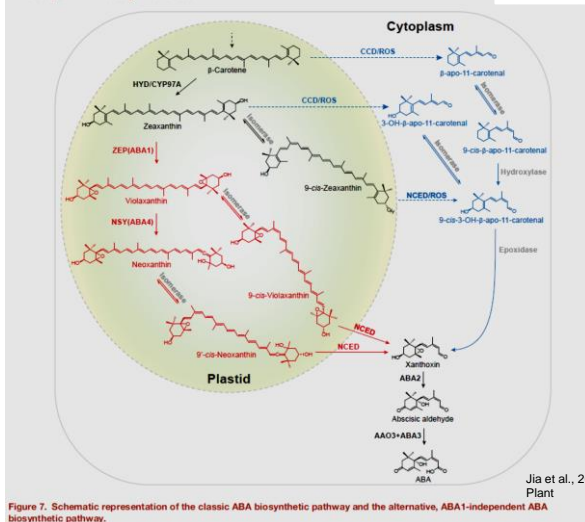
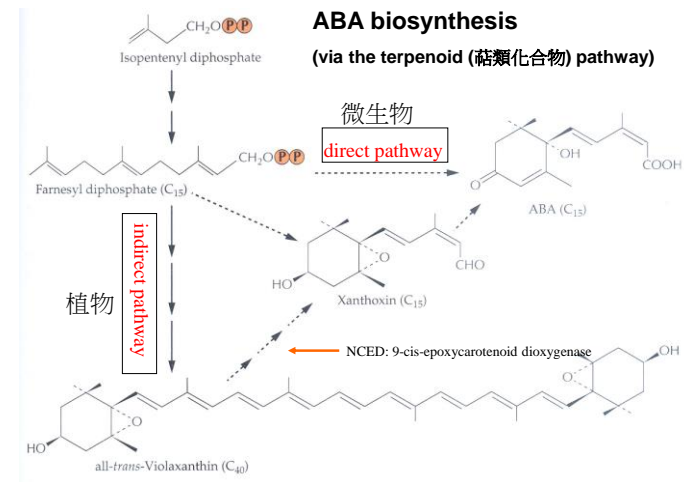
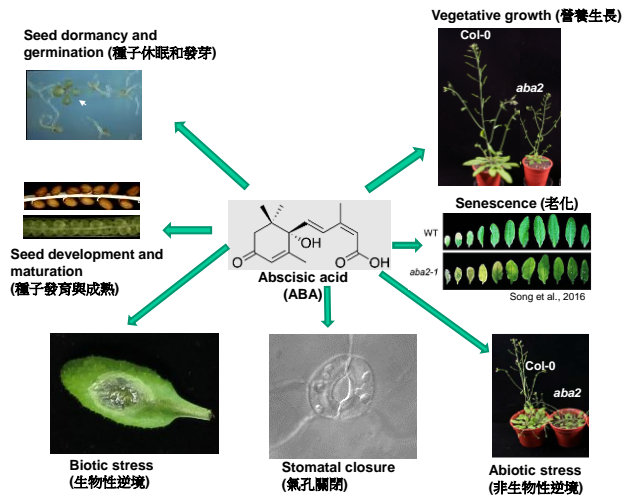


Figure 7. Schematic representation of the classic ABA biosynthetic pathway and the alternative, ABA1-independent ABA biosynthetic pathway.

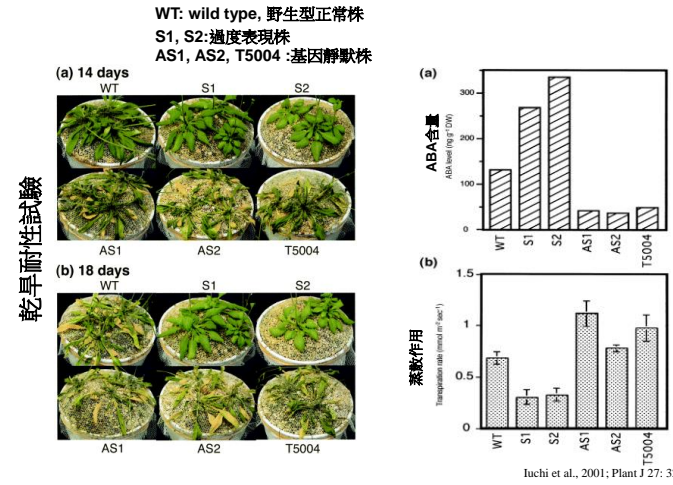


Crozier et al., 2000 in Biochemistry and Molecular Biology in Plants

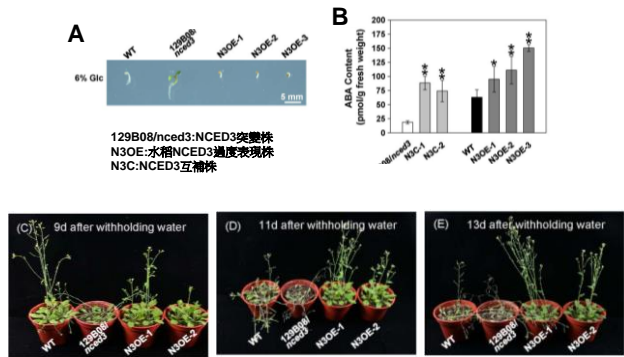
ABA affects plant growth and development



阿拉伯芥NCED3過度表現，增加ABA含量和提高乾旱耐性



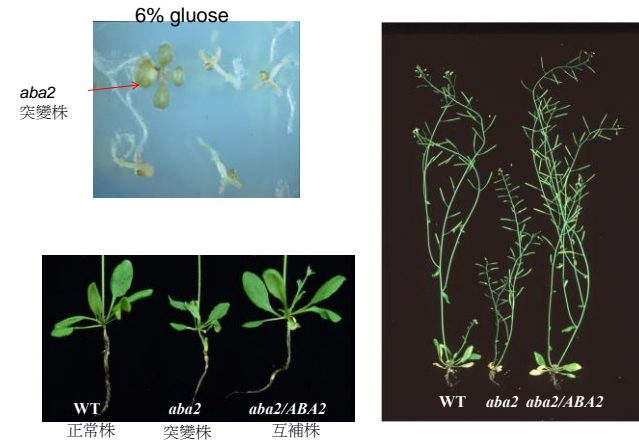
水稻NCED3過度表現，增加ABA含量和提高乾旱耐性



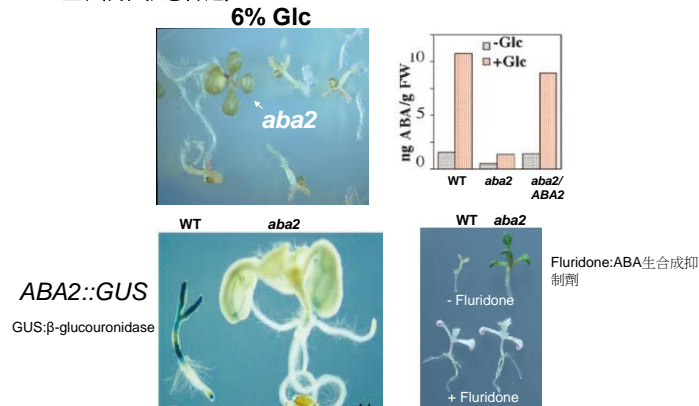
35S::OsNCED3

Hwang et al., 2010; Plant Science
Chen et al., 2011; Plant Cell Physiol

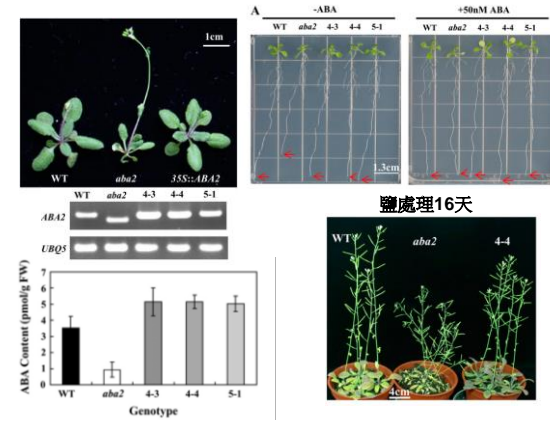
ABA2: short-chain dehydrogenase/reductase (SDR) 短鏈去氫還原酶



Sugar effects on plant growth and development partially go through ABA biosynthesis and signaling (醣類影響植物生長發育，部分是經由ABA生成和信息傳遞)



ABA2過度表現株提高ABA含量和鹽類抗性

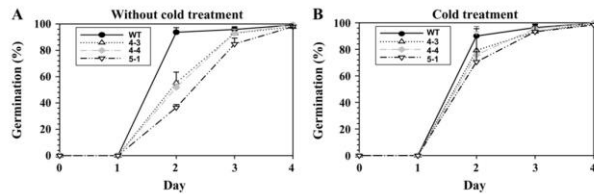


4-3, 4-4, 5-1: ABA2過度表現株

Lin et al., 2007; Plant Physiol

Over-expression of ABA2 promotes seed dormancy

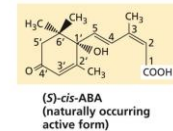
ABA2過度表現株促進種子休眠



(Lin et al., 2007; Plant Physiol)

Physiological effects of abscisic acid (ABA)

1. Seed development and maturation
2. Seed dormancy
3. Stomatal regulation
4. Adaptation to stress
5. Plant size
6. Root growth



ABA2 的組織表現

Gene: Promoter + coding sequences
 基因: 起動子 + 編碼區

ABA2::GUS GUS:β-glucouronidase



ABA2表現於維管束組織，但並不在ABA作用的位置上，如氣孔和種子內，此結果暗示ABA運送可能經由中間產物或結合物(ABA-conjugate)。

-台灣超過2百萬人罹糖尿病！40歲以下患者有增加趨勢

-It is estimated that 34% of adults in the U.S. have metabolic syndrome.

-About 28.3 million Americans have type 2 diabetes (T2D) and over 20% of middle-aged adults have prediabetes.

Abscisic Acid: A Novel Nutraceutical 營養品 for Glycemic Control (穩定血糖)

Elena Zocchi^{1*}, Raquel Hontecillas^{2,3*}, Andrew Leber², Alexandra Einerhand⁴, Adria Carbo⁵, Santina Bruzzone¹, Nuria Tubau-Juni², Noah Philipson², Victoria Zoccol-Rodriguez², Laura Sturla¹ and Josep Bassaganya-Riera^{2,3}

Frontiers in Nutrition 4: 24 (2017)

Abscisic Acid Standardized Fig (*Ficus carica*) Extracts Ameliorate Postprandial Glycemic and Insulinemic Responses in Healthy Adults

Fiona S. Atkinson^{1,*}, Agusti Villar², Anna Mulà², Andrea Zangara^{2,3,*}, Ester Risco², Carsten R. Smidt⁴, Raquel Hontecillas⁵, Andrew Leber⁵ and Iosep Bassaganya-Riera⁵

Nutrients 2019, 11, 1757; doi:10.3390/nu11081757



<https://zh.wikipedia.org/wiki>

ABA Levels in Common Foods

Food	Part	ABA, µg/g	Reference
Eureka lemon	Dried peel 果皮乾	6.5 優利卡檸檬	J. Exp. Bot., 1991, 42 (241), 1083-1088.
Lisbon lemon	Dried peel	7.8 里斯本檸檬	J. Exp. Bot., 1991, 42 (241), 1083-1088.
Red bluish grapefruit	Dried peel	3.6 紅寶石葡萄柚	J. Exp. Bot., 1991, 42 (241), 1083-1088.
Marsh white grapefruit	Dried peel	3.7 馬什白葡萄柚	J. Exp. Bot., 1991, 42 (241), 1083-1088.
Washington Navel Orange	Dried peel	6.4 臍橙	J. Exp. Bot., 1991, 42 (241), 1083-1088.
Washington Navel Orange	Dried peel	8.3	J. Exp. Bot., 1991, 42 (241), 1083-1088.
Tall Satsuma mandarin	Dried peel	2.9 溫州蜜柑	J. Exp. Bot., 1991, 42 (241), 1083-1088.
Dwarf Satsuma mandarin	Dried peel	8.3	J. Exp. Bot., 1991, 42 (241), 1083-1088.
Orange	Rind	1.1	Planta 1983, 157, 371-375
Avocado	Mesocarp	7.6 酪梨	Planta 1983, 157, 371-375
Bean	Leaves	0.08	Planta 1983, 157, 371-375
Fig	Whole	0.73 無花果	Magnone, The FASEB Journal fj.15-277731.
Bilberry	Whole	0.4 歐洲藍莓	Magnone, The FASEB Journal fj.15-277731.
Apricot	Whole	0.32 杏仁果	Magnone, The FASEB Journal fj.15-277731.
Banana	Whole	0.22	Magnone, The FASEB Journal fj.15-277731.
Potato	Whole	0.03	Magnone, The FASEB Journal fj.15-277731.
Soy milk	Whole	0.03 豆漿	Magnone, The FASEB Journal fj.15-277731.
Apple	Whole	0.024	Magnone, The FASEB Journal fj.15-277731.
Olive	Whole	0.016 橄欖	Magnone, The FASEB Journal fj.15-277731.



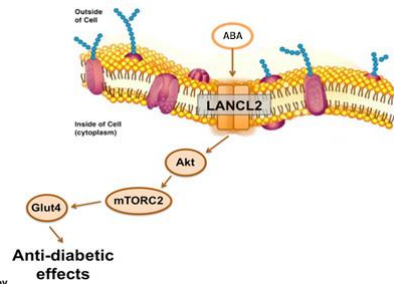
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Innovative Pathway - LANCL2

- ABA binds to lanthionine synthetase C-like 2 (LANCL2) and signals through Akt/mTORC2.
- Exerts anti-diabetic actions by up-regulating glucose transporter Glut4.

lanthionine synthetase: 羊毛硫氨酸合成酶



Abscisic acid enriched fig extract promotes insulin sensitivity by decreasing systemic inflammation and activating LANCL2 in skeletal muscle
Andrew Leber, Raquel Hontecillas, Nuria Tubau-Juni, Victoria Zoccoli-Rodriguez, Bret Goodpaster & Josep Bassaganya-Riera
Scientific Reports | (2020) 10:10463 | <https://doi.org/10.1038/s41598-020-67300-2>



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