Improved Growth and Resistance to Cold and Drought in Maize

The *Raf1* Technology Improves Photosynthesis, Growth and Recovery from Abiotic Stresses

GENETIC ENGINEERING

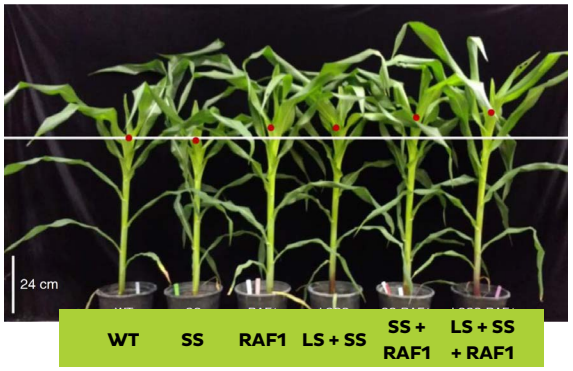
AGRICULTURE

DROUGHT AND COLD STRESS

TECHNOLOGY HIGHLIGHTS

- Increasing the accumulation and/or the activity of Rubisco in plants to boost photosynthesis is a promising approach to improving important agricultural traits.
- BTI scientists have discovered and characterized Raf1, a chaperone involved in Rubisco assembly in maize [1].
- By combining overexpression of Raf1 with overexpression of the Rubisco Small (SS) and Large (LS) subunits, our team of scientists was able to achieve significant improvements in maize.
- The modified lines exhibit:
  - Increased Rubisco accumulation and activity [2]
  - Increased plant height and fresh weight [2]
  - Reduced time to pollen and silk production [2]
  - Improved recovery from chilling stress [3]
  - Improved recovery from drought stress [4]

ENHANCED MAIZE GROWTH WITH RAF1



RAF1 overexpression increases maize growth

Plants overexpressing RAF1 and the Rubisco small (SS) and large (LS) subunits exhibits significant increases in plant height, fresh weight and dry weight in both young and mature plants [2]

LICENSING OPPORTUNITIES

Genetic engineering
Exclusive licensing is available

COLLABORATION/R&D OPPORTUNITIES

BTI and the Stern lab are seeking collaborations and partnerships to test the technology in elite lines and in the field.

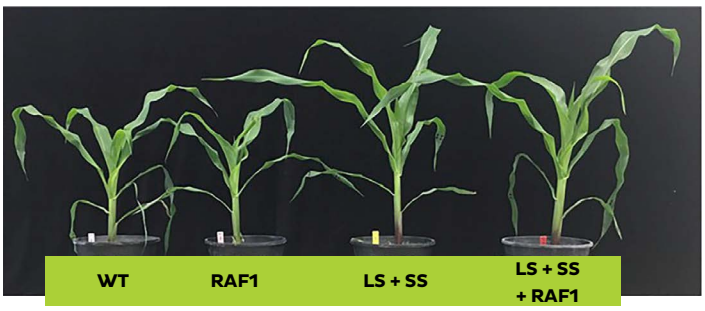
INTELLECTUAL PROPERTY

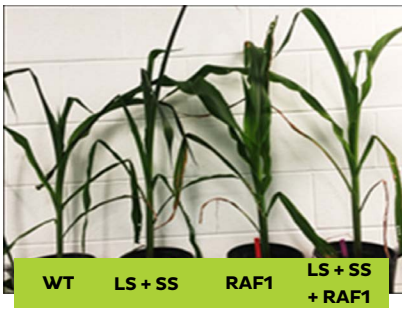
COMPOSITIONS AND METHODS USEFUL FOR THE REGULATION OF ABIOTIC STRESS RESPONSES IN HIGHER PLANTS
U.S. Application 15/371,185
Status: pending
Inventors: David B Stern and Coralie E Salesse-Smith
Assignee: Boyce Thompson Institute

Key Facts About The Technology

ENHANCED RECOVERY FROM CHILLING (left) AND DROUGHT (right) STRESS

Abiotic stress resistance
Plants overexpressing RAF1 and the Rubisco small (SS) and large (LS) subunits exhibit stronger recovery from chilling stress (Left: 3 weeks old plants were exposed for two weeks to 14°C/16-h days and 12°C/8-h nights)[3] and drought stress (Right: irrigation of 3 weeks old plants was stopped for 17 days. The photo was taken 2 days after irrigation resumed)[4]





THE *RAF1-LS-SS* Hi-II MAIZE LINE IN NUMBERS

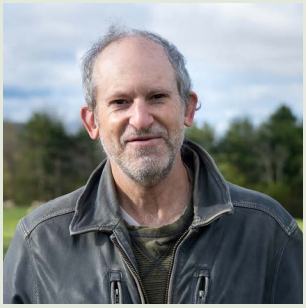
STANDARD CONDITIONS (See [2] for details)	*WT* Hi-II	*RAF1+LS+SS* Hi-II	Percent change * Significant change (P<0.005)
Height (cm)	73.2±1.8	86.2±2.5	+17.8%*
Fresh weight (g)	230.5±12.3	293.6±15.8	+27.4%*
Dry weight (g)	28.8±0.75	32.9±1.1	+14.2%
Leaf mass per area ($g.m^{-2}$)	128.8±4.6	129.0±4.7	+0.2%
Rubisco content ($\mu mol\ sites\ m^{-2}$)	11.7±0.4	15.5±0.6	+32.5%*
Rubisco activity ($\mu mol\ m^{-2}\ s^{-1}$)	35.6±2.7	52.3±2.5	+46.9%*
CHILLING STRESS (See [3] for details)			
Height (cm)	21.3±0.77	26.6±0.68	+24.9%*
Fresh weight (g)	123.4±9.4	168.1±7.0	+36.2%*
DROUGHT STRESS (See [4] for details)			
Height (cm)	102.75±2.25	123.28±1.49	+20.0%*

References

[1] Ribulose-1,5-bis-phosphate carboxylase/oxygenase accumulation factor 1 is required for holoenzyme assembly in maize. Feiz *et al.*, Plant Cell 2012 24(8):3435-46.
[2] Overexpression of Rubisco subunits with RAF1 increases Rubisco content in maize. Salesse-Smith *et al.*, Nat Plants. 2018 4(10):802-810.
[3] Increased Rubisco content in maize mitigates chilling stress and speeds recovery. Salesse-Smith *et al.*, Plant Biotechnol J. 2020 18(6):1409-20.
[4] Transgenic overexpression of rubisco subunits and the assembly factor RAF1 are beneficial to recovery from drought stress in maize. Doron *et al.*, Env Exp Bot. 2020 177-104126.

MEET OUR FACULTY/INVENTOR

David Stern is Plant Biology Professor affiliated with the School of Integrative Plant Science at Cornell University. The Stern lab at BTI studies chloroplast biology, bioenergy and nuclear-cytoplasmic interactions. Areas of emphasis include the roles of ribonucleases and RNA-binding proteins, and the assembly and catalytic activity of the carbon-fixing enzyme Rubisco.



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