

Seventh Asian Cotton Research and Development Network (ACRDN)
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**IDENTIFICATION AND
CHARACTERISATION OF *LIM* GENES
IN *Gossypium arboreum***

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LIM PROTEINS:

LIM proteins are cysteine-rich, homeodomain containing proteins

Novel cysteine-rich motif and homeodomain in the product of the *Caenorhabditis elegans* cell lineage gene *lin-11*

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Freyd et al 1990, Nature,
344, 876–879

Insulin gene enhancer binding protein *Isl-1* is a member of a novel class of proteins containing both a homeo- and a Cys–His domain

Olof Karlsson, Stefan Thor, Torbjörn Norberg,
Helena Ohlsson & Thomas Edlund*

Department of Microbiology, University of Umeå, S-901 87 Umeå, Sweden

Karlsson et al 1990, Nature
344, 879–882

mec-3, a Homeobox-Containing Gene That Specifies Differentiation of the Touch Receptor Neurons in *C. elegans*

Jeffrey C. Way and Martin Chalfie
Department of Biological Sciences
Columbia University
New York, New York 10027

Way and Chalfie, 1988, Cell
54, 5–16

LIM proteins are named after *lin11*, *Isl-1*, and *mec-3* homeodomain proteins discovered in animals

Proteins comprised of a novel cysteine-rich zinc-binding domain described in mammals, amphibians, flies, worms and plants.



Occurrence of LIM proteins in flowering plants

The First LIM protein identified in plants is from Sunflower, initially it was called as SF3, subsequently renamed HaPLIM1 (Baltz et al 1992a; 1999), together with actin known to participate in pollen growth development.

Till now, the LIMdomain containing proteins has been identified in Arabidopsis, Populus, Oryza, Nicotiana, Eucalyptus, Gossypium, Glycine , Brassica and Cicer arietinum

Structure of LIM proteins

It Contains cysteine rich homedomain with consensus sequence of

[C-X2-C-X16-23-H-X2-C]-X2-[C-X2-C-X16-21C-X2-3-(C/D/H)]

It essentially known to have two zinc fingers linked together by a short two-amino acid space



Functions of LIM Proteins

Nuclear LIM domain proteins - tissue specific gene regulation as transcription factor and cell fate determination

Cytoplasmic LIM domain proteins - cytoskeletal organisation through regulation of actin dynamics

Dual function of LIM Proteins is reported in Tobacco (Moes et al 2013) and Cotton (Han et al 2013)



Role of LIM domain family of proteins

A cotton LIM domain-containing protein (GhWLIM5) is involved in bundling actin filaments

Li et al 2013; Plant Physiol Biochem, 66:34-40

Cotton LIM domain-containing protein GhPLIM1 is specifically expressed in anthers and participates in modulating F-actin

Li et al 2015, Plant Biol. 2015; 17(2): 528–534

A LIM domain protein from tobacco involved in actin-bundling and histone gene transcription.

Moes et al 2013 Mol Plant ; 6(2):483–502.



Strong and finer fibers in over expressed lines of WLIM1a

Dual functions of WLIM1a in cell elongation and Secondary wall formation in Developing Cotton fibres

Table 3. Comparison of Fiber Quality Parameters between Wild-Type and *WLIM1a*-Overexpressing Plants

Plant	Fiber Length (mm)	Micronaire Units	Fiber Strength (cN/tex)	Fiber Maturity Ratio
Wild type	28.07 ± 0.85	→ 4.7 ± 0.14	→ 29.9 ± 0.94	1.40 ± 0.31
406	31.06 ± 0.68	3.75 ± 0.12	32.8 ± 0.65	1.39 ± 0.25
286	30.87 ± 0.59	→ 3.8 ± 0.08	→ 32.6 ± 0.86	1.39 ± 0.29
41	30.81 ± 0.76	3.8 ± 0.21	32.1 ± 0.78	1.40 ± 0.31

Values are mean ± SD for samples of wild-type and *WLIM1a*-overexpressing plants (lines 406, 286, and 41). The fiber length, micronaire, fiber strength, and fiber maturity ratio were measured at the National Center for Evaluation of Fiber Quality (Anyang, China). cN/tex: Centi-Newton per Tex.

Fibre length by aiding fibre elongation via actin filament bundling

Fibre strength- It works as **transcription factor to activate the expression of genes in the phenylpropanoid pathway**

Han et al 2013, The Plant Cell, 25:4421-4438

Sub families of Plant LIM domain Proteins:

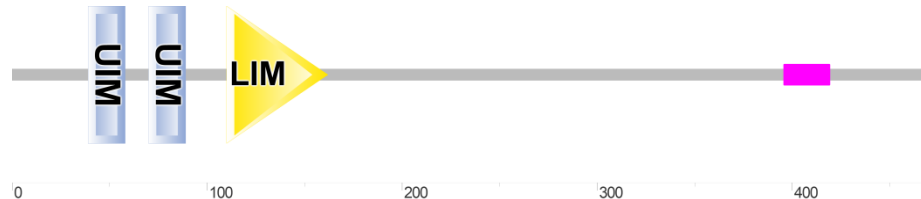
1. **LIM Proteins similar to Cysteine Rich Proteins (CRPs) of animals:** The LIM domain comprised of two zinc fingers linked together by a short two-amino acid spacer with some differences like long C-terminal and absence of glycine rich regions (GRR)



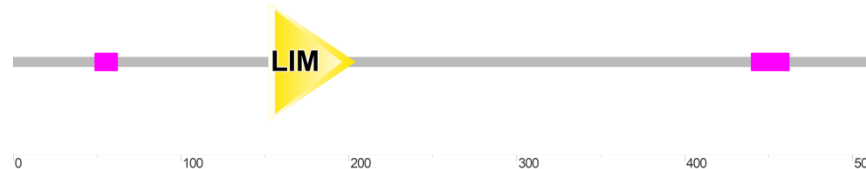
2. **Plant specific LIM proteins:**

High Molecular weight protein, contains single LIM domain, either presence (DA1) or absence (DAR) of UIMs (Ubiquitin Interacting Motifs) at N-terminal together with DUF3633 at C-terminal

DA1



DAR



Based on expression pattern:

PLIM1 & 2 specifically expressed in pollen

WLIM1 & 2 expressed in whole plant

Role of Plant specific LIM family:

Control of final seed and organ size by the DA1 gene family in Arabidopsis thaliana.

Li et al 2008, GENES & DEVELOPMENT 22:1331–1336

The Ubiquitin Receptor DA1 Interacts with the E3 Ubiquitin Ligase DA2 to Regulate Seed and Organ Size in Arabidopsis

Xia et al 2013, The Plant cell

The Ubiquitin Receptors DA1, DAR1, and DAR2 Redundantly Regulate Endoreduplication by Modulating the Stability of TCP14/15 in Arabidopsis

Peng et al 2015, The Plant Cell, Vol. 27: 649–662

Role of Plant specific LIM family

RESEARCH ARTICLE

Genome Wide Identification of *LIM* Genes in *Cicer arietinum* and Response of *Ca-2LIMs* in Development, Hormone and Pathogenic Stress

GBE

GENOME BIOLOGY AND EVOLUTION

Genome-Wide Analyses of a Plant-Specific LIM-Domain Gene Family Implicate Its Evolutionary Role in Plant Diversification

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Response of LIM genes to Biotic and abiotic stress



Identification and characterization of LIM genes in *G. arboreum*

1. How many LIM family genes present in *G. arboreum*?
2. Occurrence of Subfamily of GaLIM genes?
3. Chromosomal distribution of GaLIM family genes?
4. Exon/intron structure of GaLIM family genes?
5. What is the similarity per cent among GaLIM family genes at protein level?
6. Phylogenetic grouping of GaLIM with characterized LIMs(PLIM & WLIMs) of Arabidopsis, Oryza and Populus ?
7. Is expression pattern validates with Phylogeny?
8. Is plant specific subfamily of GaLIM responds to stresses?



**Remaining slides containing unpublished data
are retained for publication in referred journal**

THANK YOU

