GENETIC ANALYSIS OF THE SHOOT APICAL MERISTEM IN MAIZE

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Shoot Apical Meristem, maize, shootmeristemless mutant

The Shoot Apical Meristem is established during embryogenesis and is a key event in the plant development; it is the source of stem cell as well as the site of organ formation. Because of the importance of SAM function in plant development, the mechanisms of formation, maintenance and function are crucial questions in plant developmental biology.

A useful tool to investigate the SAM is the analysis of mutants impaired in its organization, like the sml and dgr maize mutants described below.

The sml (shotmeristemless) gene is a recessive mutation affecting shoot apical meristem maintenance and lateral organ formation. Its introgression in different genetic backgrounds has highlighted the epistatic interaction between sml and the unlinked distorted growth (dgr) gene. Seeds homozygous for both sml and dgr have a shootless phenotype whereas Dgr/-sml/sml seeds produce plants with many developmental abnormalities (dgr mutant).

Sml gene lies on the long arm of chromosome 10. Its position has been defined by B-A translocations mapping followed by the linkage analysis with visible as well as molecular markers.

The dgr phenotype displays a variety of plant and leaf abnormalities and the severity of leaf defects may vary widely within a single mutant plant, including half leaf, thread leaf and narrow leaf phenotype.

The inflorescence is also affected exhibiting male flower sterility, ears often developing secondary ears in husk leaf axils at the base of the main ear and female flower showing extra silks.

This phenotype can be due to a defective dgr SAM. The morphological analysis and the detection of the shoot marker gene expression domain in mutant apices will reveal its organization.

The histological analysis of mutant seedlings reveals that in the dgr shoot the L1 outer layer cell shape is less regular than in the wild-type. The L1 layer plays a key role in the shoot being necessary for maintenance of indeterminacy in the underlying meristem layers, and for the specification of the adaxial fate.

In maize adaxial/abaxial leaf polarity is established by an abaxial gradient of microRNA166 which spatially restricts the expression domain of HD-ZIPIII transcription factors that specify adaxial fate.

Recessive mutation in lbl1 lead to a variable abaxialization of leaves, showing a phenotype very similar to the dgr plant; Lbl1 gene is involved in the biogenesis of trans-acting small interfering RNAs that acts on the adaxial site of developing leaves and demarcates the domain of hd-zipIII and miR166 accumulation.

The analysis of the dgr leaf polarity and the double mutant sml-lbl1 will define the relationship between these genes.