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# **Molecular genetic analysis of plant *Mei2*-like genes**

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for the Degree of Doctor of Philosophy in Plant Biology

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## **Thesis Abstract**

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Molecular and genetic methods were used to analyse how a novel class of genes, plant *Mei2*-like genes may be involved in the regulation of morphogenesis in plants. The study specifically aimed to 1) further characterise maize *te1* (the first plant *Mei2*-like gene to be genetically analysed) and understand the morphological basis of the *te1* mutant phenotype and 2) analyse the function of *Arabidopsis* *Terminal Ear Like* (*TEL*) genes using expression analyses and reverse genetics strategy.

*te1* maize mutants are initially characterised by abnormal phytomer formation and development. A more detailed morphological analysis shows that mutant plants 1) have smaller vegetative shoot apices than the wild type, 2) initiate leaves at a higher, more distal position on the apical dome and 3) have higher plastochron ratio. Molecular analyses of *kn1* expression pattern, a marker of leaf founder identity, show that downregulation of *kn1* transcripts occur higher up the dome. Clonal analyses show that fewer number of leaf founder cells are recruited to form the leaf.

*TEL1* and *TEL2* are expressed in distinct overlapping domains in the undifferentiated region of the shoot apical meristems during the embryo, vegetative and reproductive stages of *Arabidopsis* development suggesting involvement of these genes in regulating meristem development and subsequent maintenance. The distinct expression of *TEL1* in both the embryonic SAM and RAM raises the possibility of a unifying regulatory mechanism in the formation of the root and the shoot. The absence of *TEL* single knockout phenotypes supports the idea of functional redundancy. When the *TEL* genes were both knocked out, double mutant phenotypes show apical-basal pattern defects, ectopic production of numerous secondary shoots, production of numerous leaves and basic embryonic pattern defects such as deletions of apical and/or basal region of the seedling.

Results of this study support the hypothesis that plant *Mei2*-like genes are important in regulating morphogenesis in plants and that they are required in the early patterning of the basic plant body.

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## ***Gene nomenclature***

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Genes and gene products are named as follows:

### ***Arabidopsis***

*GENES* are capitalised and italicised

*GENE TRANSCRIPTS* are capitalised and italicised

PROTEINS are capitalised

*mutant* plants are named after the gene, in lower case, italicised

### **Maize**

*genes* are written in lower case, italicised

PROTEINS ARE capitalised, <sup>not</sup> italicised

<sup>is</sup> *Mutants* are named after the gene, in lower case, italicised

### **Yeast (*S. pombe*)**

*genes* are written in lower case, italicised ie. *mei2*

Proteins are written with the first letter capitalised, <sup>not</sup> italicised as in  
Mei2p

### **Groups of genes**

*Mei2-like*

*TEL* Terminal Ear-Like

## Abbreviations

---

|       |  |
|-------|--|
| Amp   | ampicillin                                   |
| BCIP  | x-phosphate/5- bromo-chloro-indoyl-phosphate |
| DMPC  | dimethylpyrocarbonate                        |
| DEPC  | diethylpyrocarbonate                         |
| DIG   | Digoxigenin                                  |
| DMSO  | dimethylsulfoxide                            |
| DTT   | dithiothreitol                               |
| EDTA  | disodium ethylene diamine tetra acetate      |
| Kan   | kanamycin                                    |
| LB    | Luria Bertanni medium                        |
| NBT   | 4 Nitroblue tetrazolium chloride             |
| ng    | nanogram                                     |
| NaOAc | sodium acetate                               |
| NTP   | nucleotide triphosphates                     |
| PBS   | phosphate buffered saline                    |
| PCR   | polymerase chain reaction                    |
| RAM   | root apical meristem                         |
| rpm   | revolutions per minute                       |
| RRM   | RNA recognition motif                        |
| SAM   | shoot apical meristem                        |
| SDS   | sodium dodecyl sulphate                      |
| $\mu$ | micron                                       |
| °C    | degrees Celsius                              |

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