Seed Germination and Viability

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Mucilage Mutant

Wild type

Mutant
Triphasic Imbibition Curve

PHASE I  PHASE II  PHASE III

Water Content (%)

Imbibition Time (h)
Embryoless Seeds

- Normal
- Immature
- Decayed
- Empty
Damage by Insects
Shrunken Seeds

Kristof JR, Nonogaki H, unpublished results
Mutant Embryos

Kristof JR, Nonogaki H, unpublished results
Developmental Problems

Wild type  Mutant  Mutant

Kristof J R, Nonogaki H, unpublished results
Undifferentiated Embryos

Kristof JR, Nonogaki H, unpublished results
Abnormal Embryos

Wild type

Mutant

Kristof JR, Nonogaki H, unpublished results
Various Seed Morphology

A

Type I  Type II  Type III  Type IV  Type V

Embryo growth at the germinative stages

Germination

Continuation of developmental program

No Germination

ABA

B

Embryo growth at the germinative stages

Germination

Continuation of developmental program

No Germination

ABA

water
Living Endosperm

Embryo

Endosperm

Carrot seeds
Embryo Growth during Germination
Two Opposite Forces

Embryo

Growth potential

Endosperm

Mechanical Resistance
Tomato Seed
Embryo Growth

Endosperm

Embryo
Elongation Zone
Mechanical Resistance of the Endosperm
De-capped Seeds

Chan T, Nonogaki H, unpublished results
Thick Cell Walls

Endosperm cap

Middle lamella

Galactomannans
Endosperm Weakening

Cell wall proteins (e.g., EXP, XTH and MAN)

Chen et al., 2001; Journal of Experimental Botany 53, 215-223
Endosperm Weakening

Cantliffe et al., 1984
Reserve Mobilization

Physiological role

Mannan mobilization

Seedling Establishment
Postgerminative Mannanase
Onion Stand Establishment

Raven et al., 1999; Biology of Plants, Esau 1977; Anatomy of Seed Plants
Healthy Stand Establishment

Kan^r  WT
miRNA Mutants
miRNA Mutants

A

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<th>3 d</th>
<th>4 d</th>
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B

4 d

WT

SPL13

mSPL13

5 d
miRNA Mutants

0 d

2 d