Meiosis: Apomixis

Section IV-F

Clarification

Hojsgaard and Hörandl, 2019

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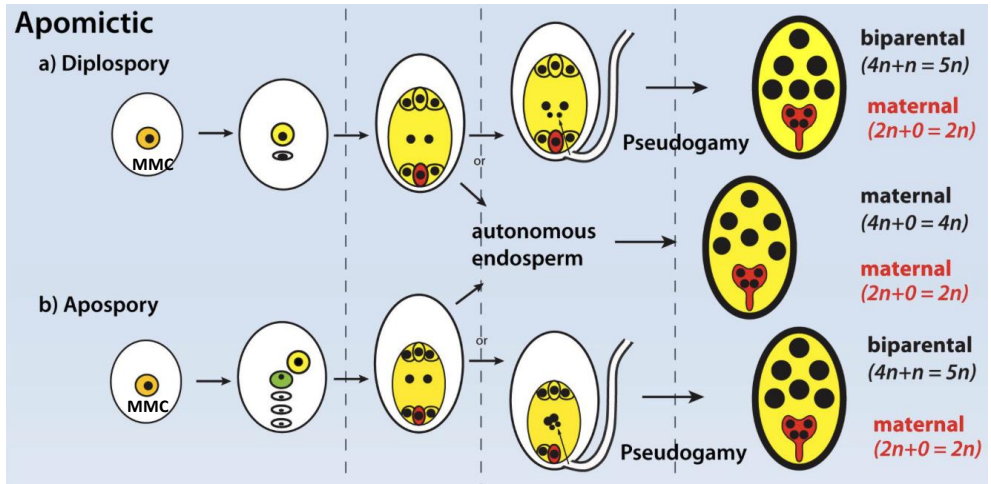
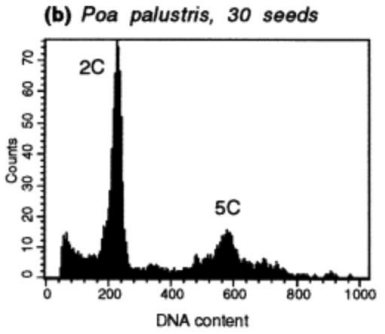
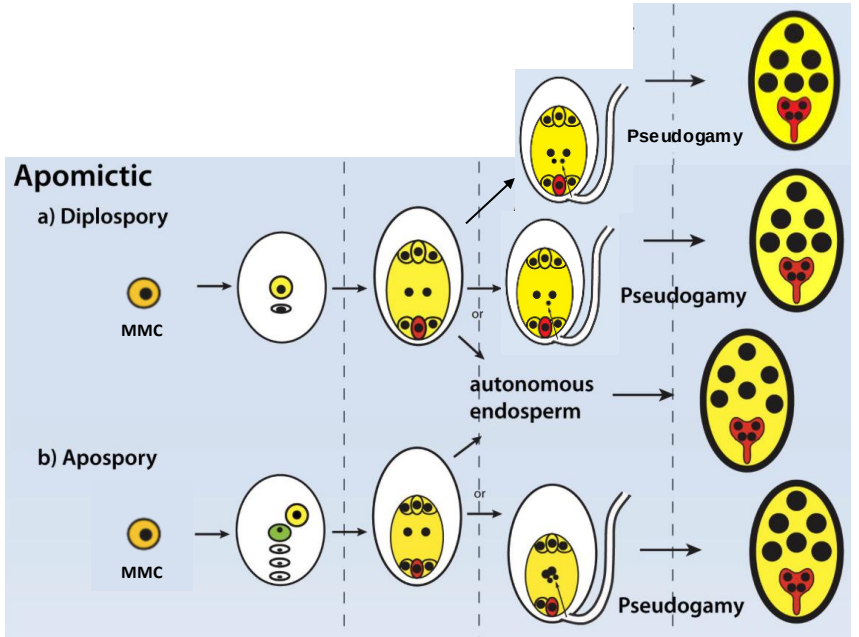


Matzk et al, 2001





Endosperm (pseudogamous): 6C (4m:2p)
Embryo (apomictic): 2C (2m)

OR

Endosperm (pseudogamous): 5C (4m:1p)
Embryo (apomictic): 2C (2m)

OR

Endosperm (autonomous): 4C (4m)
Embryo (apomictic): 2C (2m)

Engineering Apomixis

Requirements Q

1.

2.

3.

1.

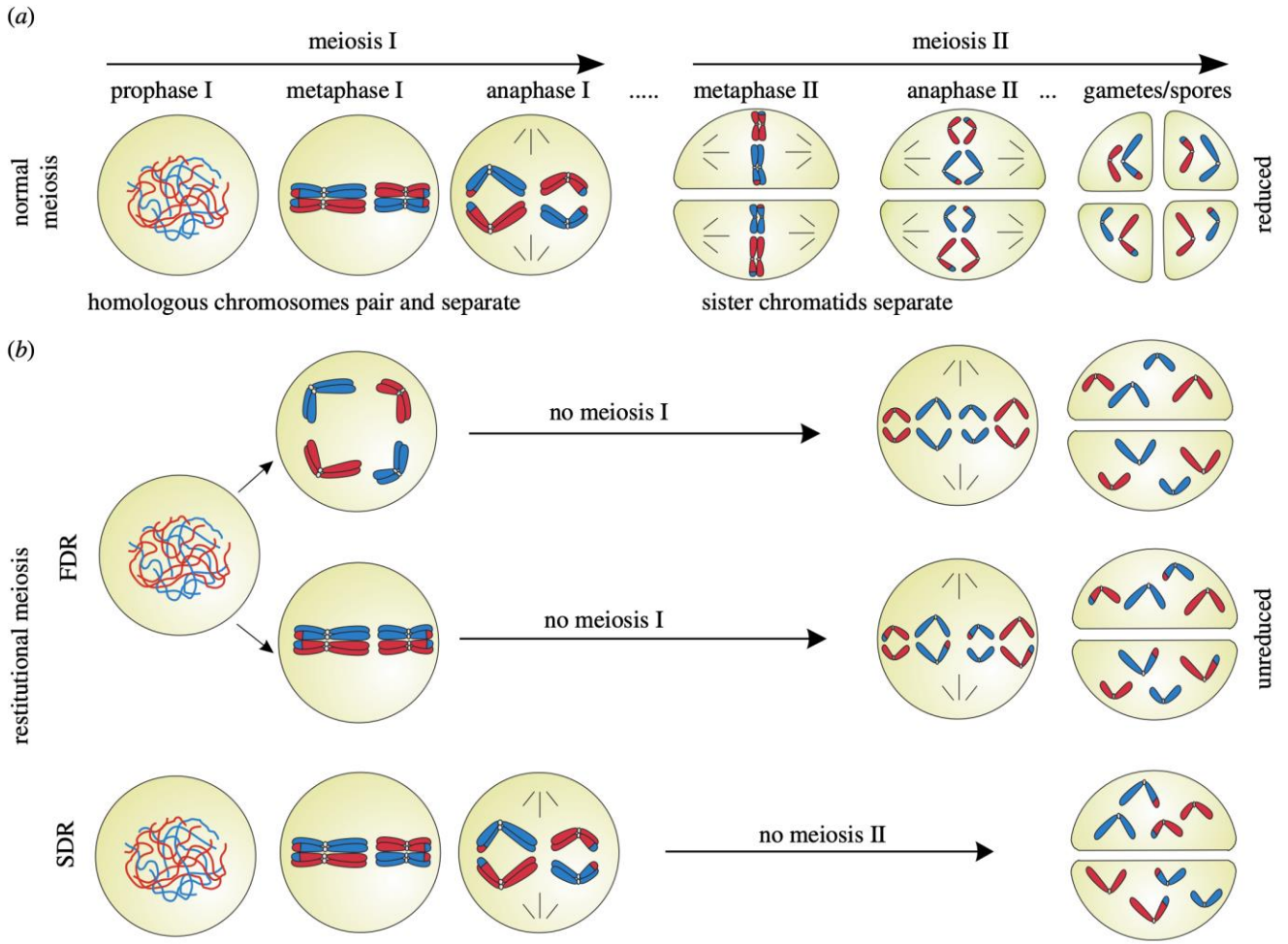
Meiosis vs mitosis Q

1.

2.

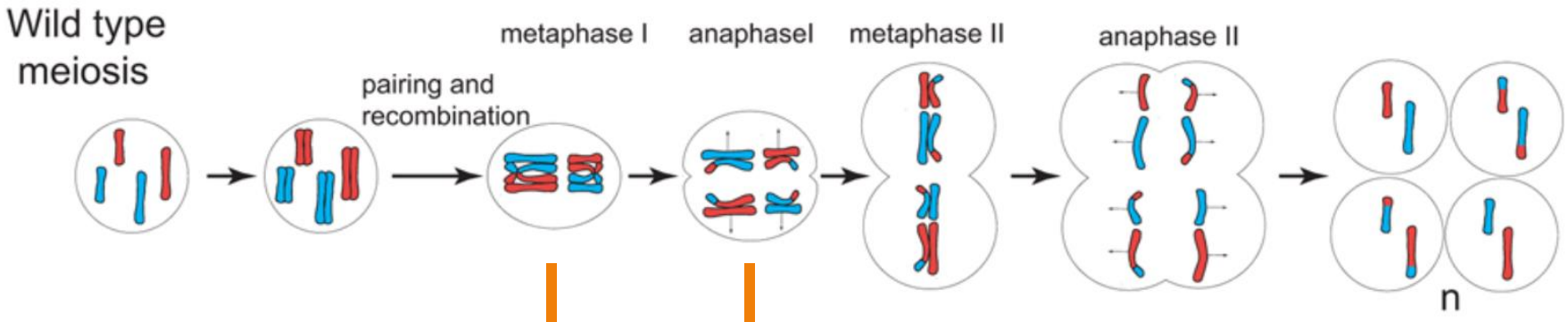
3.

Mirzaghaderi and Horandl. 2016

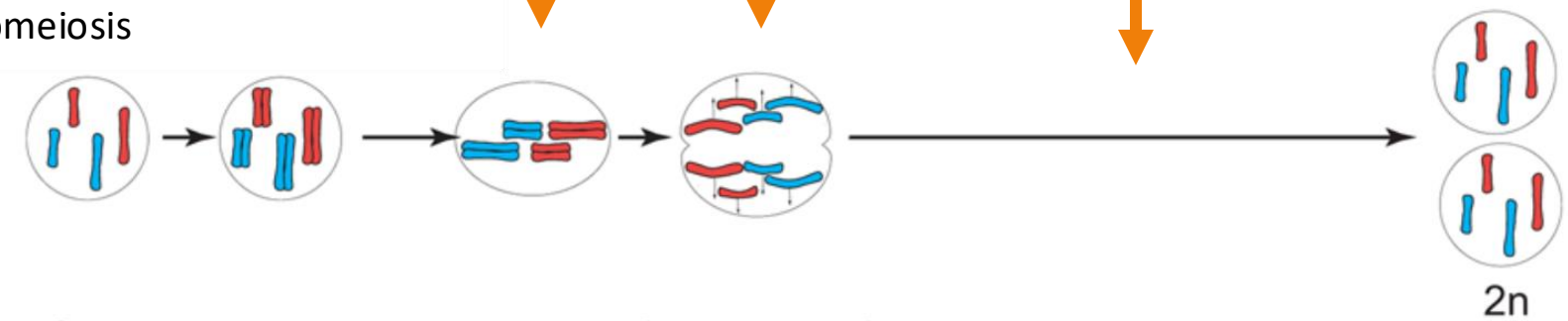


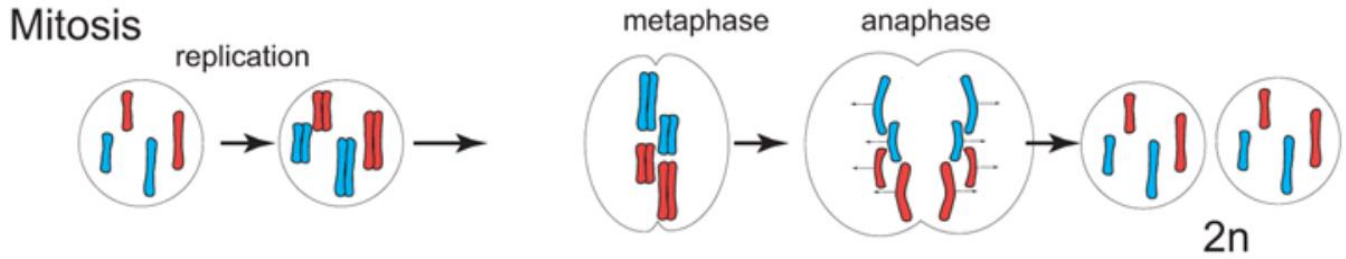
Engineering Apomeiosis

d'Erfurth et al. 2009



Our goal: Apomeiosis



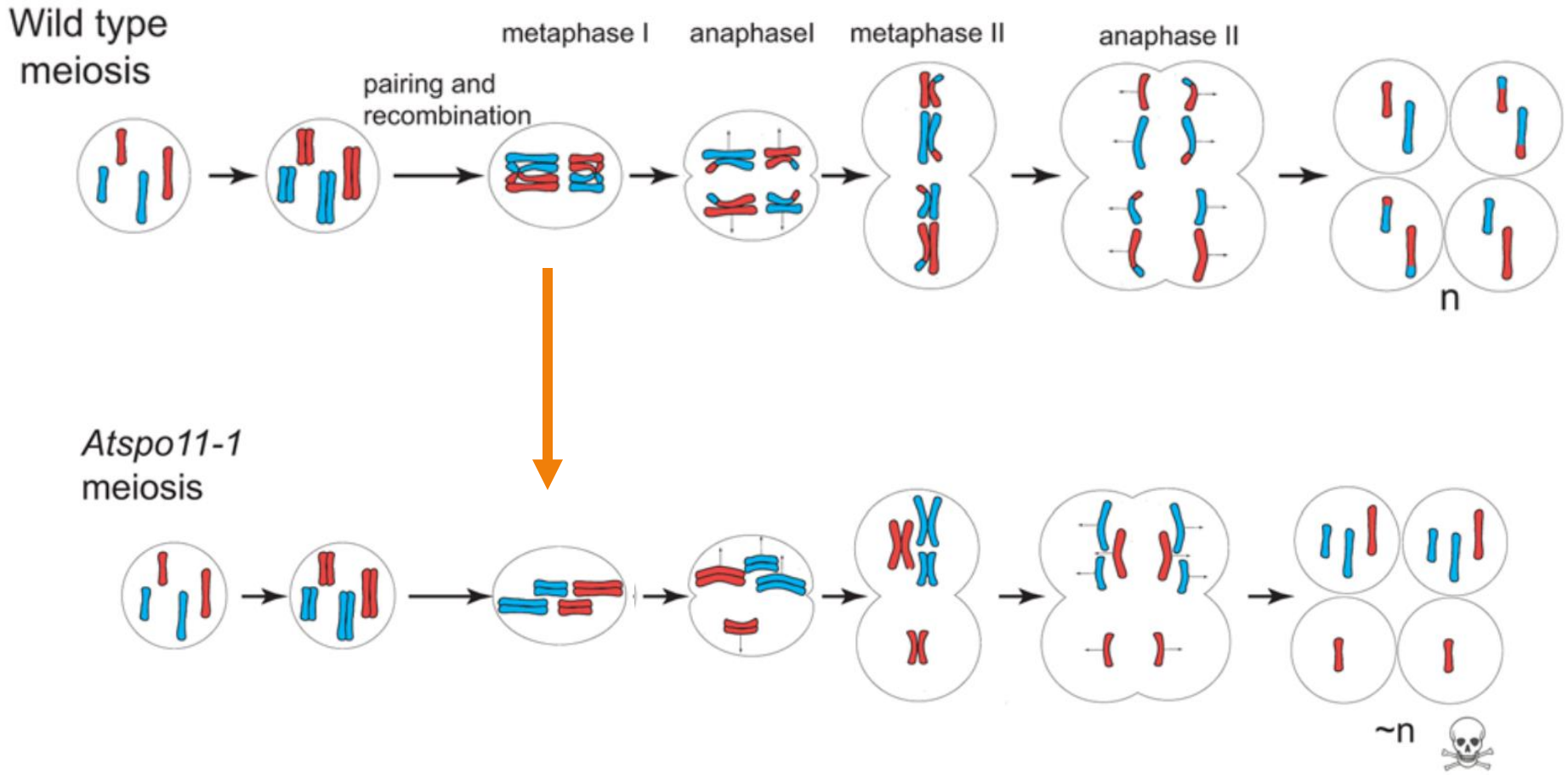


Engineering Apomeiosis.

1.

d'Erfurth et al. 2009

- Remember SPO11 ?

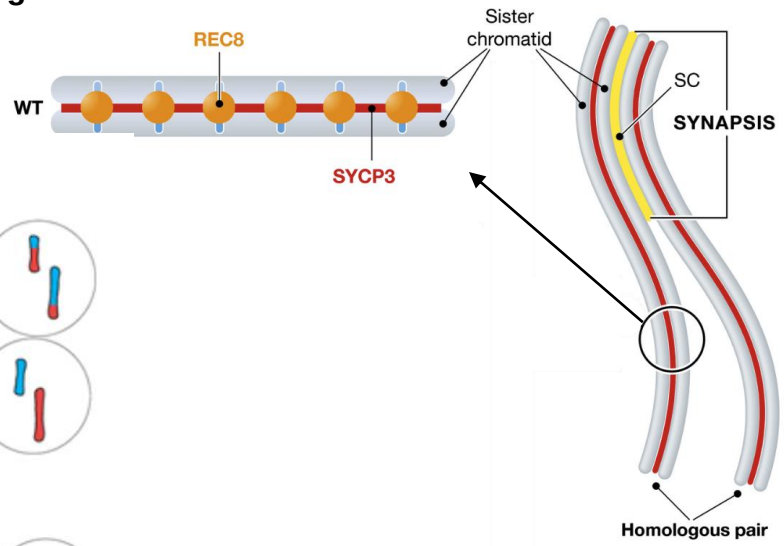


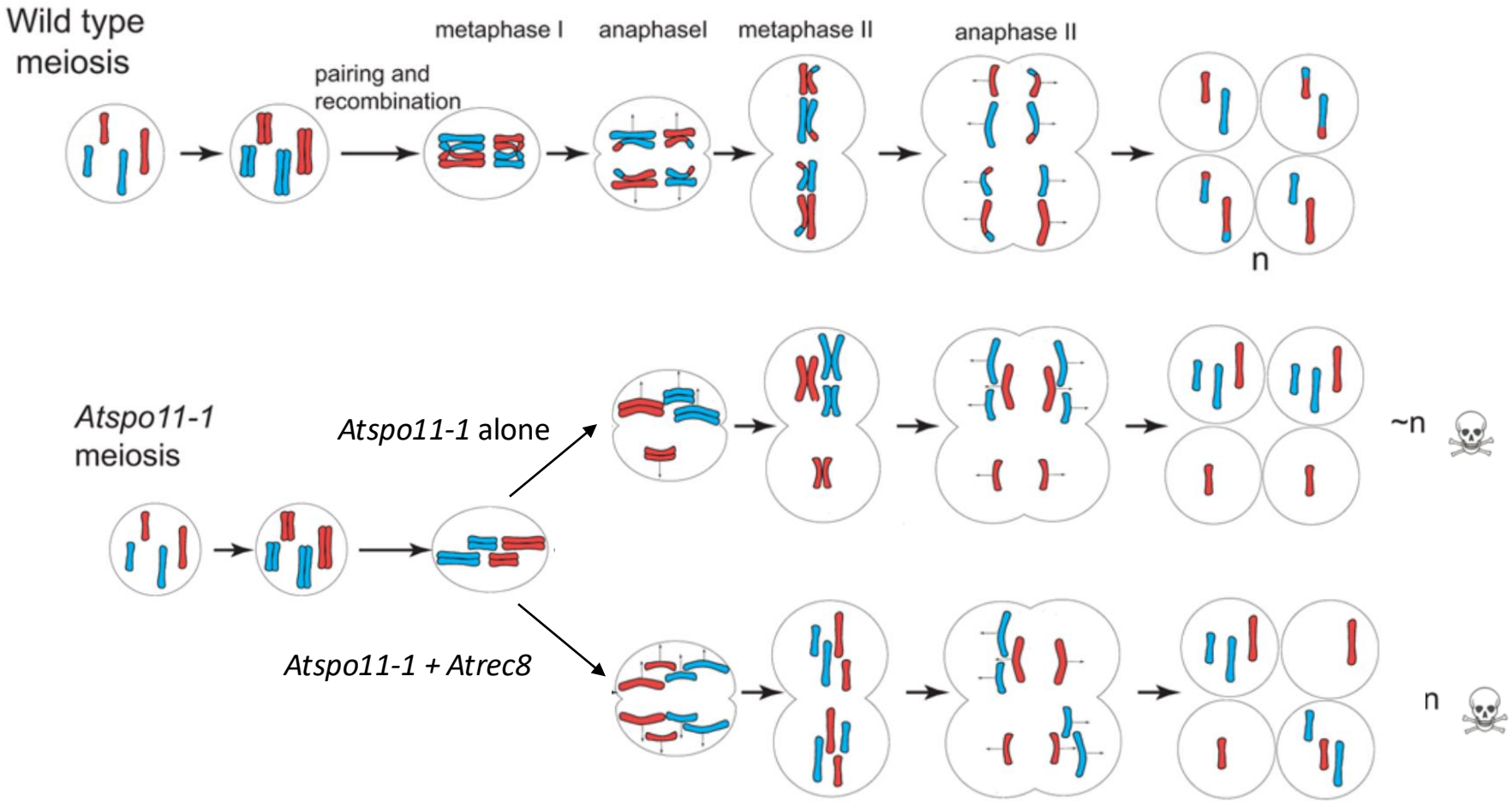
Engineering Apomeiosis.

2.

- REC8: helps to maintain sister-chromatid cohesion.

Ishiguro & Watanabe. 2016





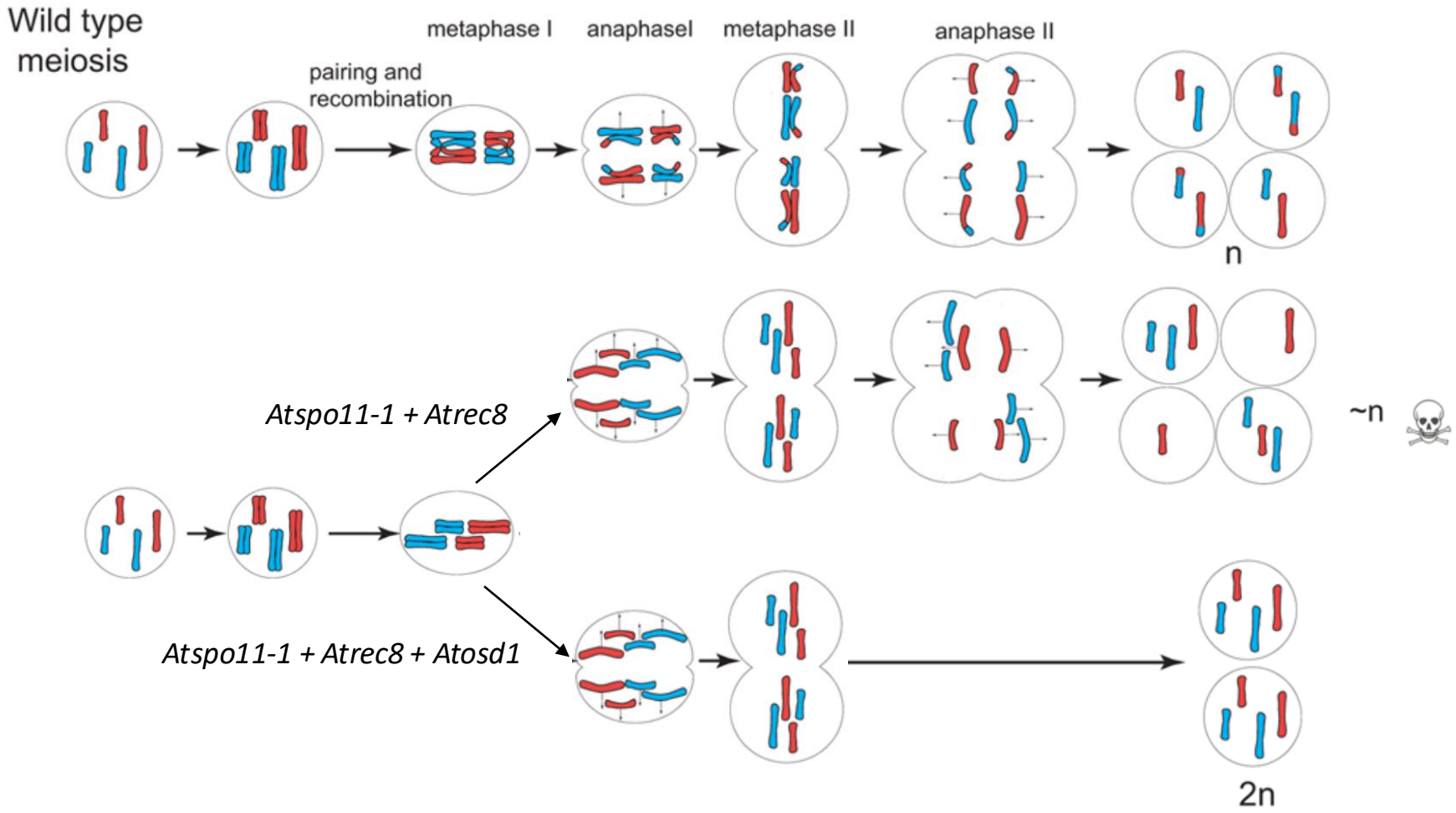
d'Erfurth et al. 2009

Engineering Apomeiosis.

d'Erfurth et al. 2009

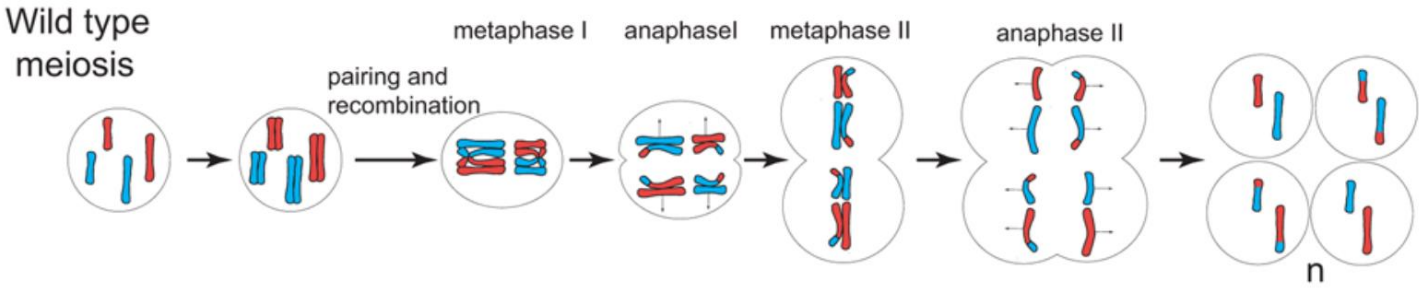
3.

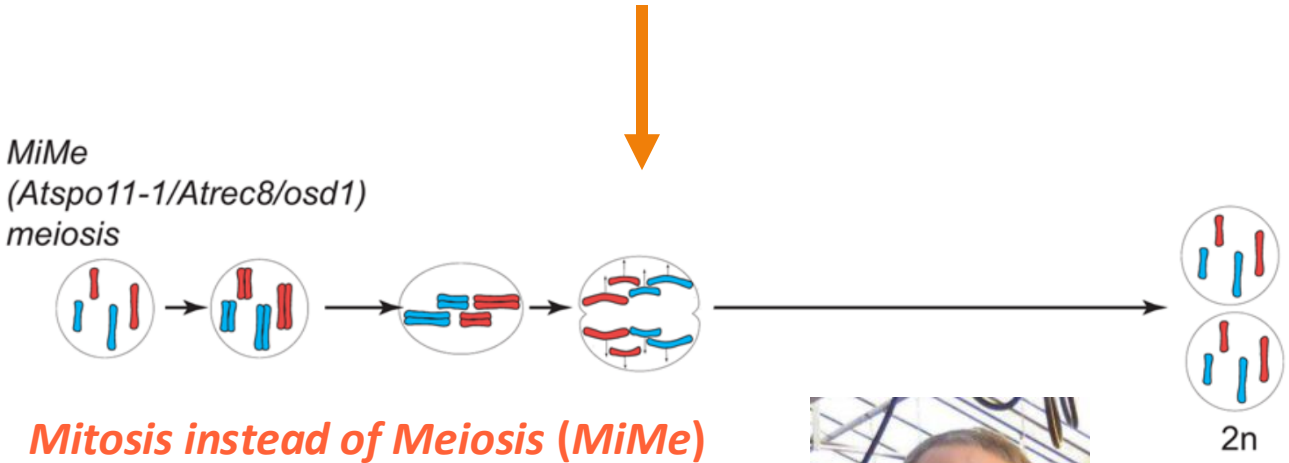
- Achieved by mutating *OSD1* gene (*Omission of 2nd Division*)



Engineering Apomeiosis.

d'Erfurth et al. 2009





Mitosis instead of Meiosis (MiMe)

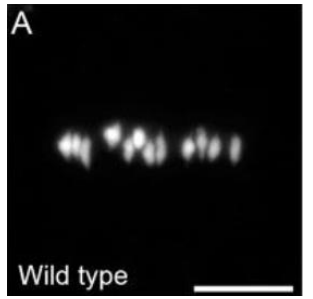
~ 100 % penetrance

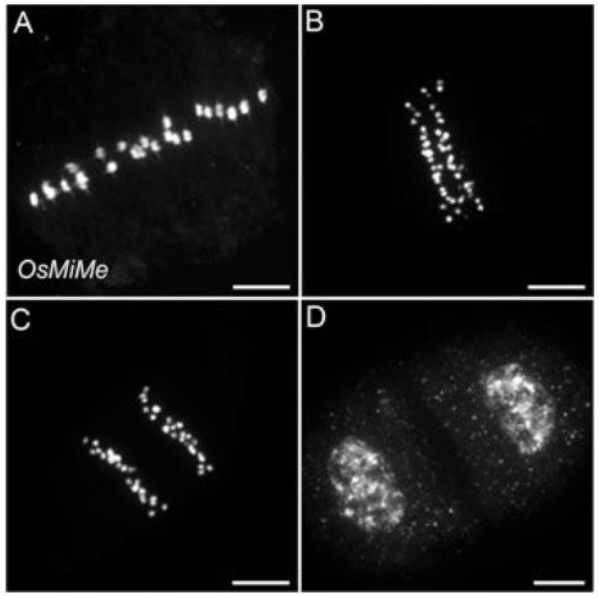
botanic.cam.ac.uk

Raphaël Mercier

Mieulet et al., 2016

- Engineering *MiMe* in rice with CRISPR.



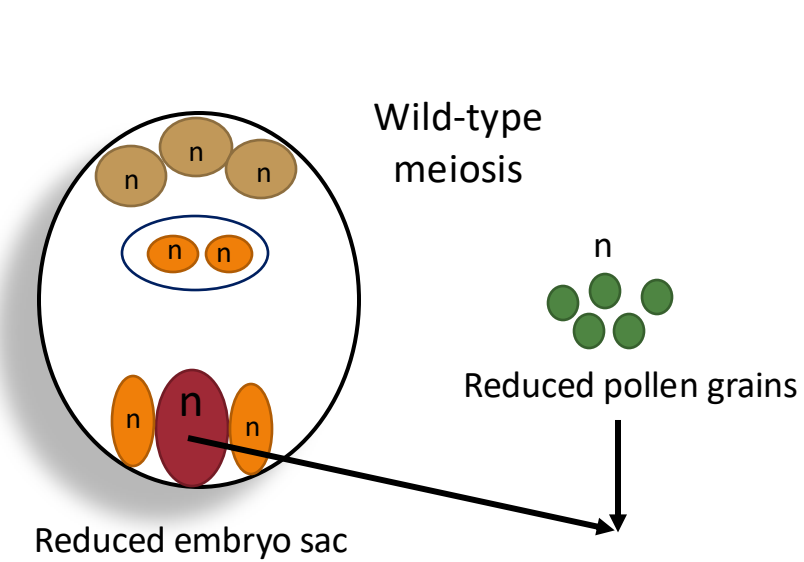


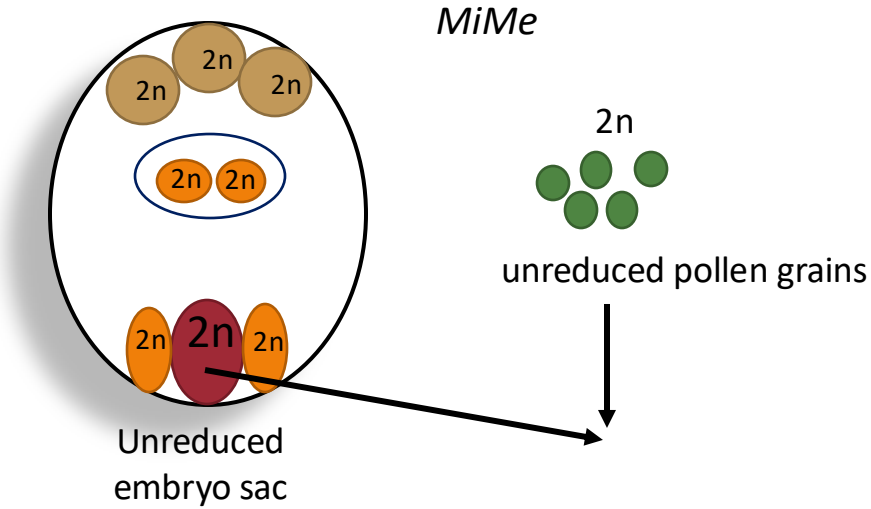
- *MiMe* in tomato (Wang et al. 2024) Q

MiMe alone ?

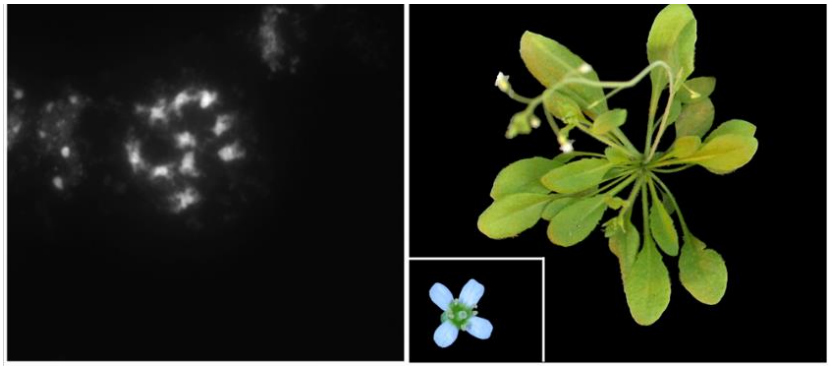
Graphics by Lovepreet Chahal

d'Erfurth et al. 2009

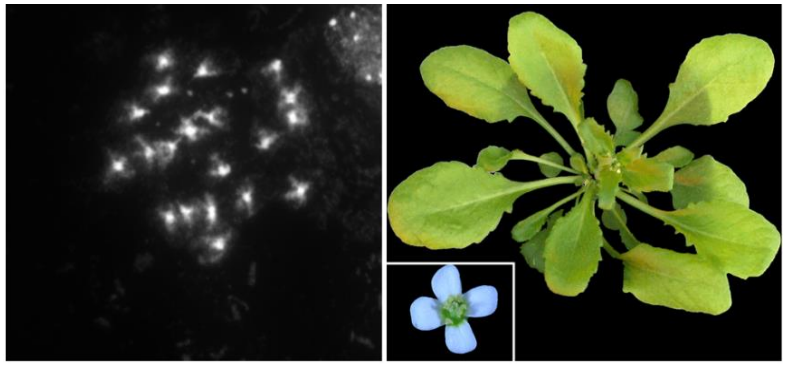




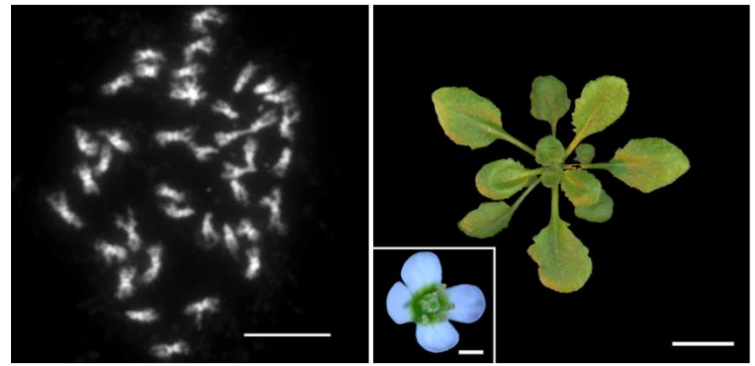
T_0: 2n = 2x = 10



T_1: 2n = 4x = 20



T_2: 2n = 8x = 40



Parthenogenesis

***PsASGR-BBML* gene**

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Peggy Ozias-Akins

Joann Conner

Boutilier et al. 2002

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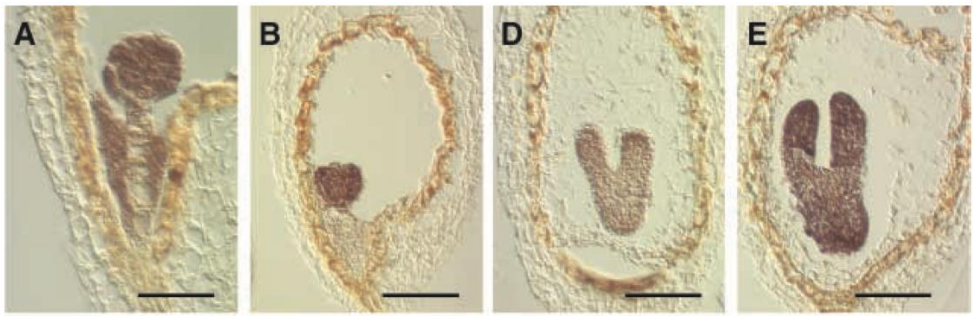
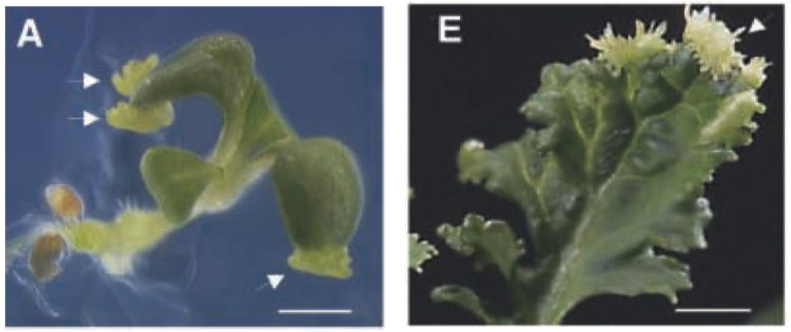
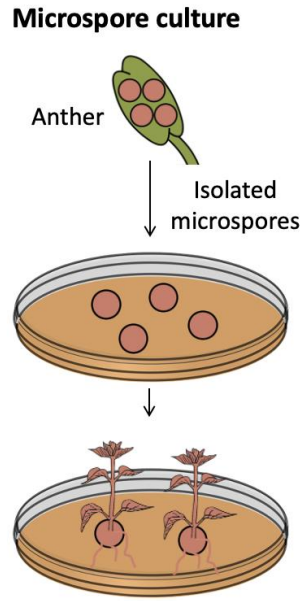


In situ localization of *AtBBM* mRNA in Arabidopsis embryos.



Somatic embryo formation in *35S::BnBBM* Arabidopsis (A) and *Brassica napus* (E).



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Q

Parthenogenesis

***PsASGR-BBML* gene** **Conner et al., 2015 and 2017**

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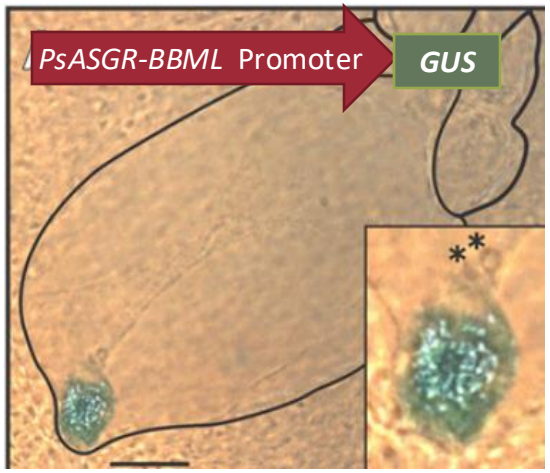

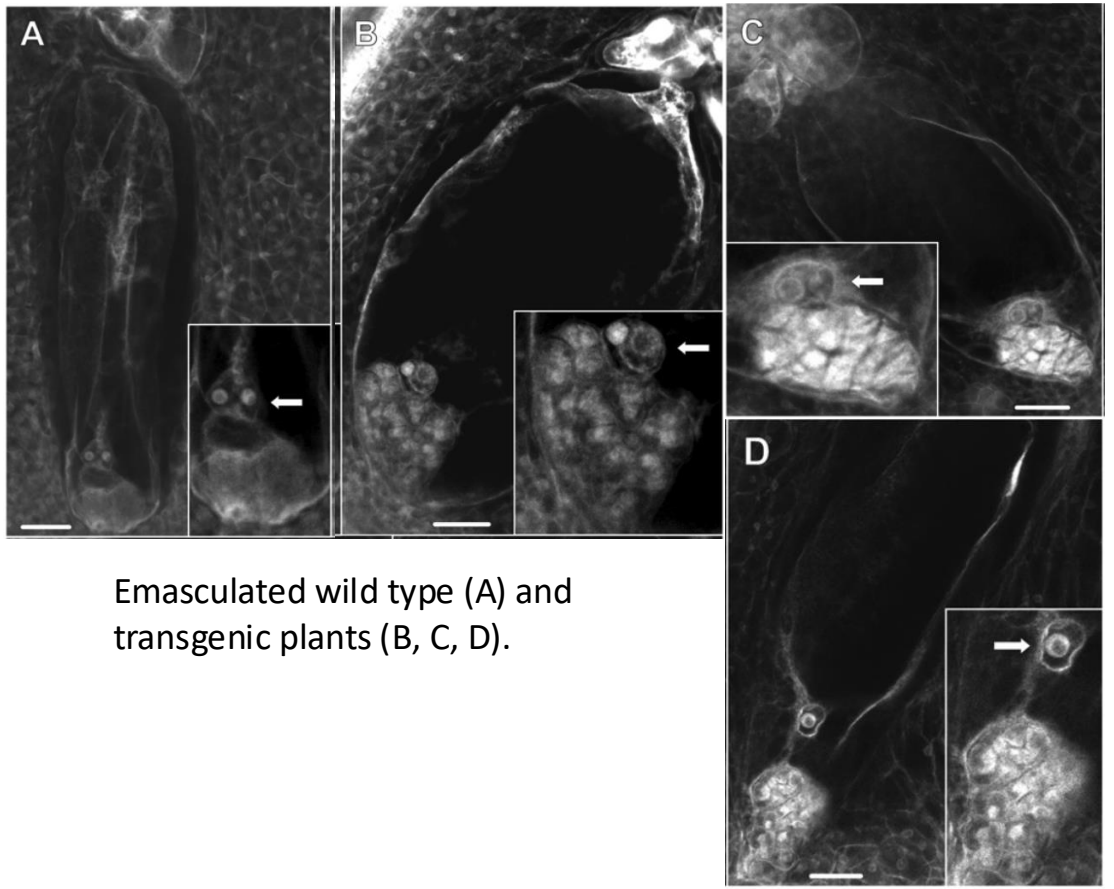

Emasculated wild type (A) and transgenic plants (B, C, D).

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Parthenogenesis

Gene expression in gametes and zygotes

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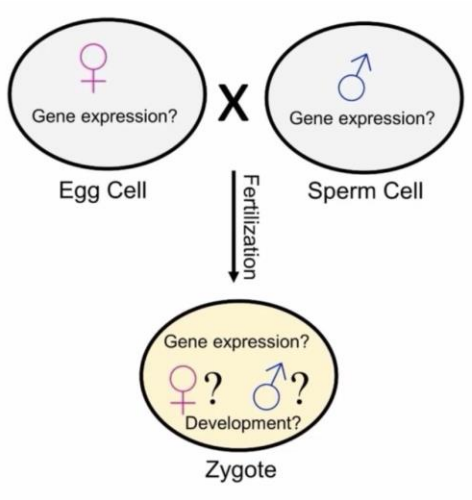
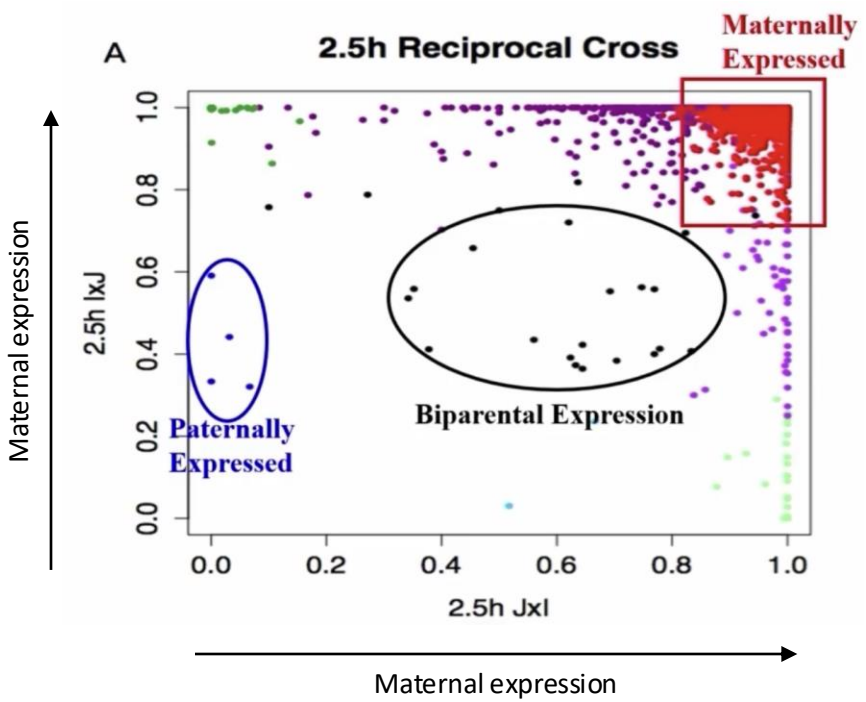


Venkatesan Sundaresan

Anderson et al. 2017



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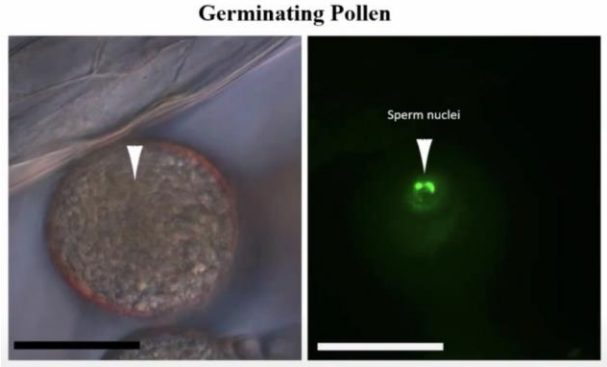
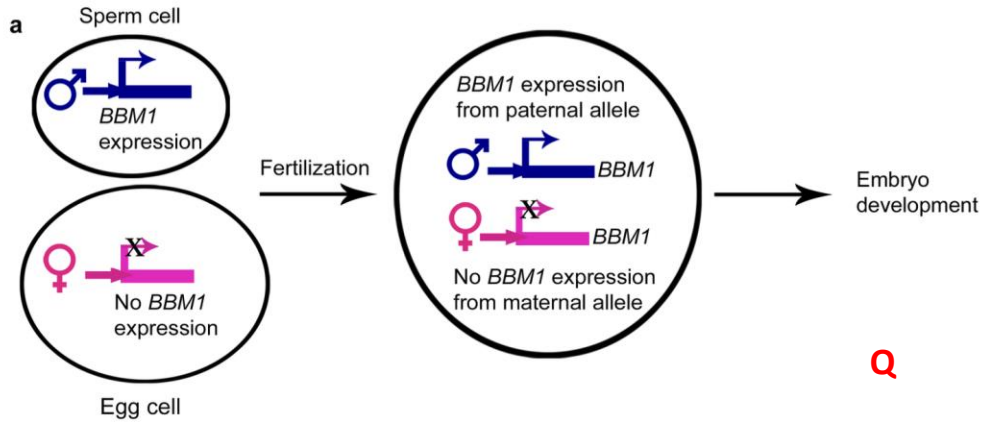


promoter OsBBM1::OsBBM1-GFP

Parthenogenesis

OsBBM1 **Khanday et al. 2019**



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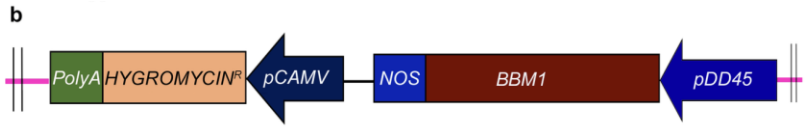

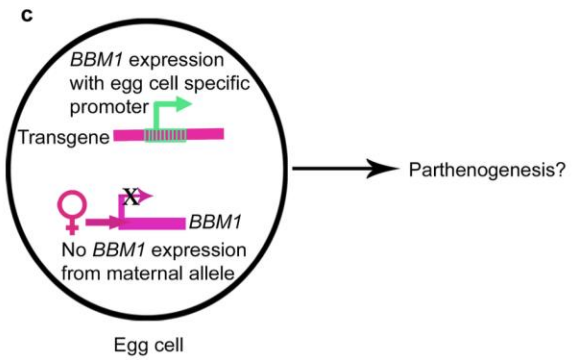

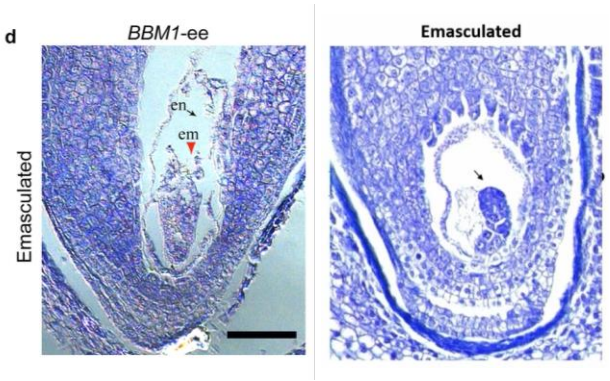

Q

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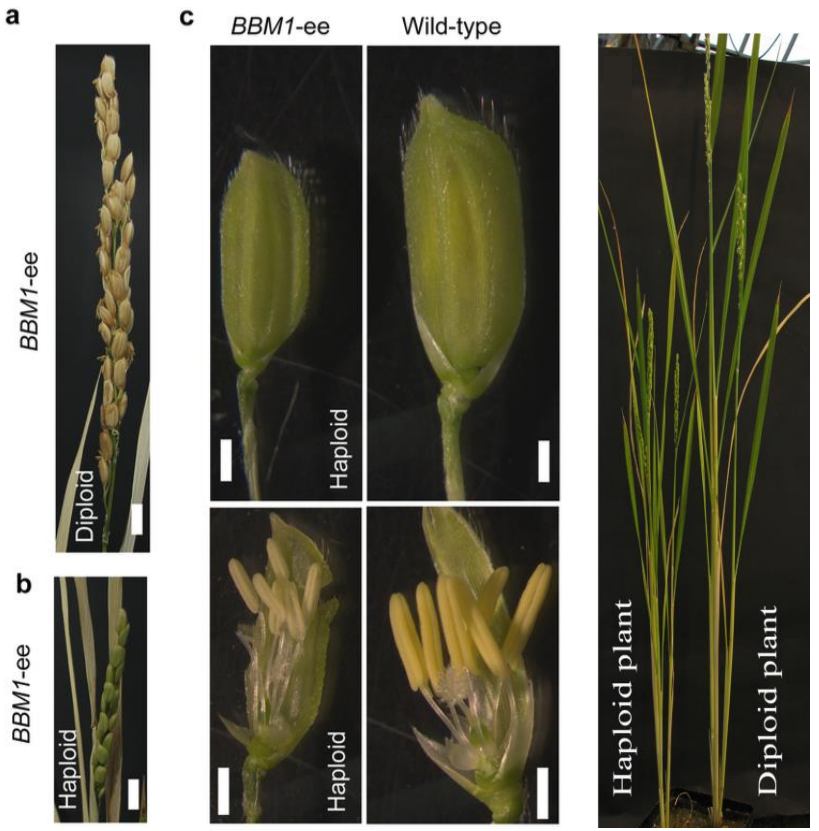
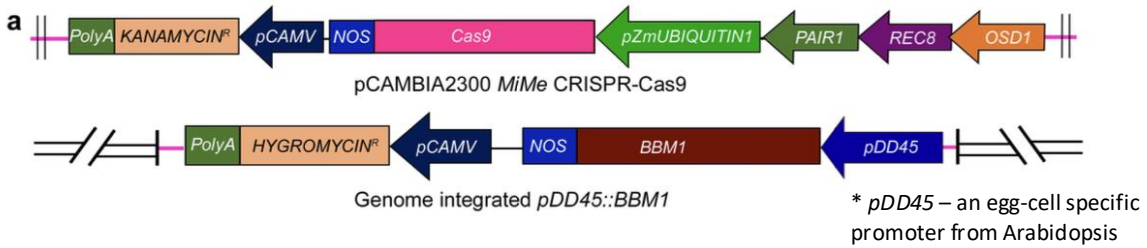
Q

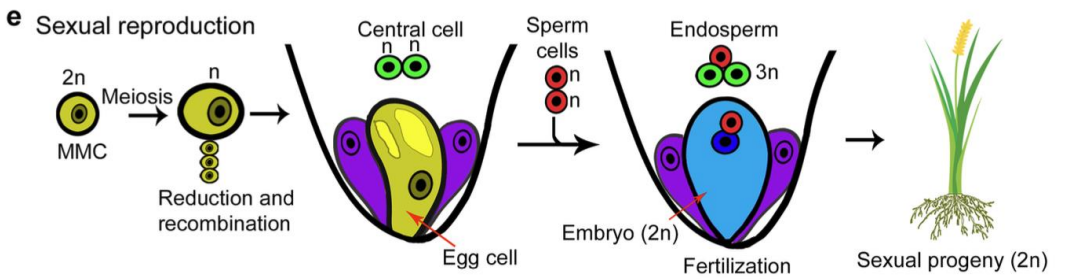


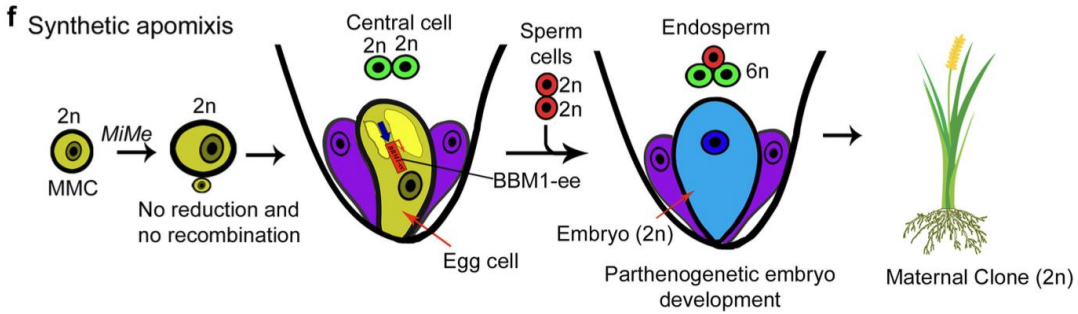
Synthetic apomixis = *Mime* + Parthenogenesis

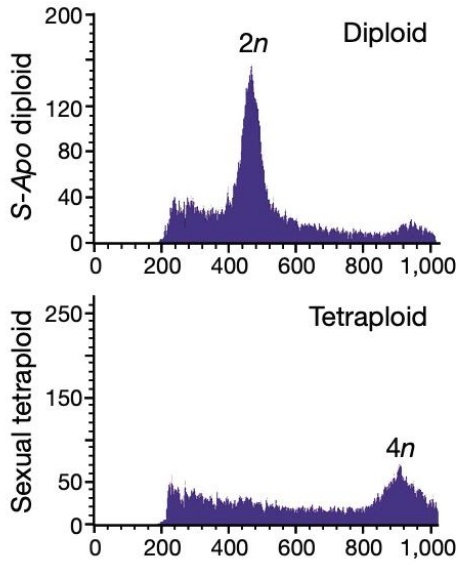
Synthetic Apomixis (*S-Apo*) in Rice **Khanday et al. 2019**



* *pDD45* – an egg-cell specific promoter from Arabidopsis







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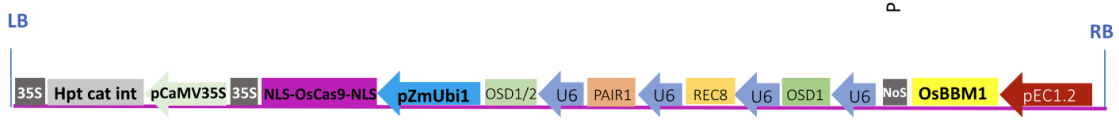
Synthetic apomixis = *Mime* + Parthenogenesis

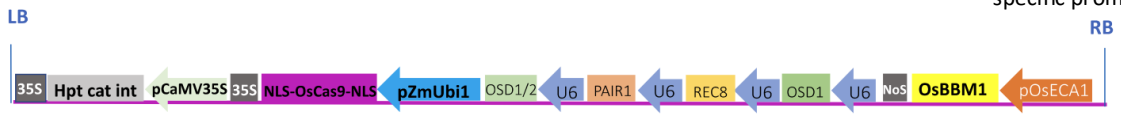
Synthetic Apomixis (*S-Apo*) in Rice **Vernet et al. 2022**

- Commercial Hybrid BRS-CIRAD 302 (developed in France).



T314 : sgRNA MiMe_pAtECS:BBM1

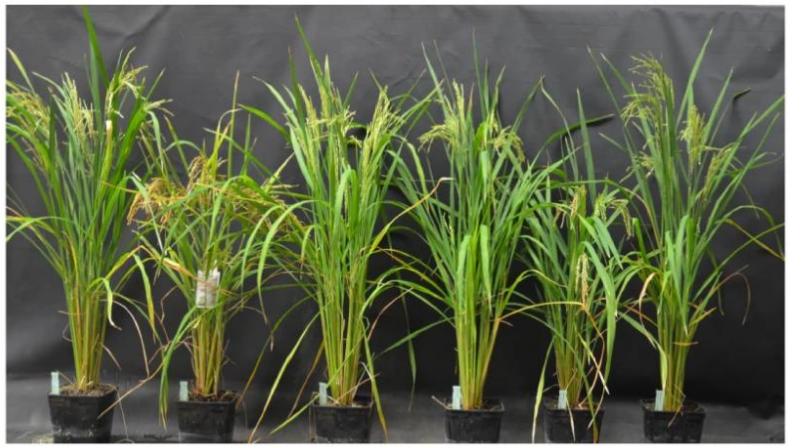
* *pDD45/pEC1.2* – an egg-cell specific promoter from Arabidopsis



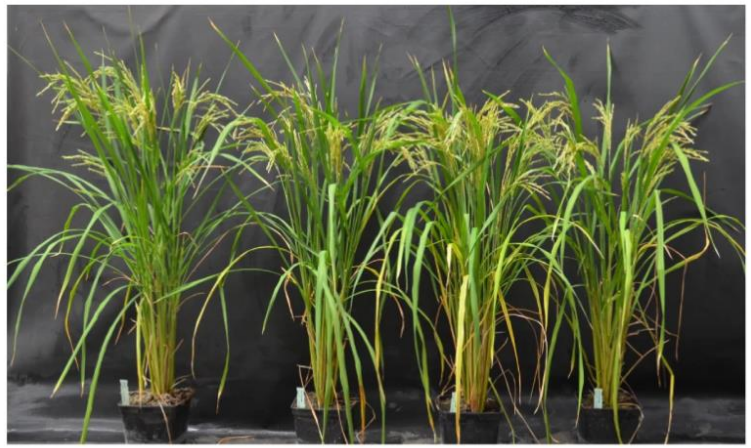
T315 : sgRNA MiMe_pOsECS:BBM1

* *OsECA.1* is rice ortholog of *pEC1.2*

- ~ 95 % penetrance of synthetic apomixis.



F1 ——— F2 progeny ———



F1 — T1 apomictic progeny —

initiative20X20.org, science.org, ucdavis.edu