WAGENINGEN UNIVERSITY
PLANT SCIENCES

KONINKLIJKE ALGEMEENE VEREENIGING VOOR BLOEMBOLLENCULTUUR

SEED LAB WAGENINGEN

Morphological and molecular characterization of dormancy induction and release of vegetative buds in flower bulbs

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Background

The flower bulb industry in the Netherlands is dominated by tulips and lilies. A flower bulb consists of a modified short stem containing thickened petioles (bulb-scales), an apical bud and a varied range of axillary meristems also called vegetative buds (Figure 1). Once the buds are formed they undergo a period of quiescence until the right environmental and internal factors release them from this dormancy. Therefore, initiation and outgrowth of vegetative buds including dormancy induction and release determine together the success of vegetative propagation in flower bulbs. Among flower bulbs, Lily (*Lilium spp*.) constitutes a good model system to study vegetative bud development and dormancy related processes due to the relative easiness and fast initiation of its vegetative buds (bulblets) when culturing detached bulb-scales (Figure 2).

Objective

To elucidate the molecular regulation of dormancy induction and release on vegetative buds in Lily.

Research plan

To dissect the process in detail at the morphological level, followed by profiling of candidate-gene expression to allow the identification of the most suitable time-points for an RNAseq approach (Figure 3).

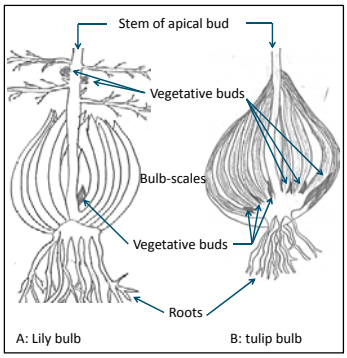


Figure 1. Anatomy of most economically important flower bulbs in The Netherlands. A: cross section of a lily bulb. B: cross section of a tulip bulb.

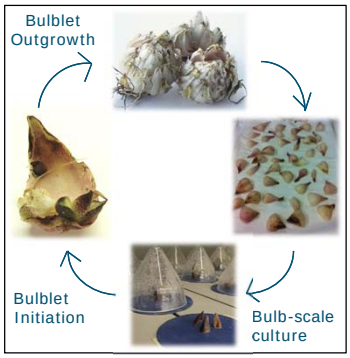
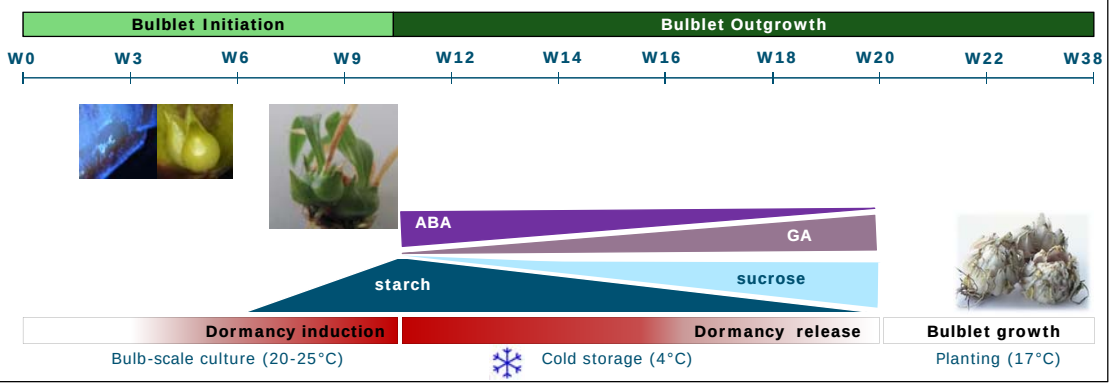


Figure 2. Lily artificial propagation (scaling) as a model system to study vegetative bud development, dormancy induction and release in flower bulbs.

1. Morphological and physiological characterization of the system

✓ Understanding developmental and physiological processes during bulblet initiation and outgrowth in relation to dormancy induction and release.



2. Candidate gene expression profiling

✓ Quick overlook of hormonal and sugar dynamics occurring in the bulblet along dormancy induction and release.
✓ Identification of time-points that provide sufficient transcriptional variation to perform a genome-wide expression profiling.

Dormancy related	Sugar related
▪ *MORE AXILLARY BRANCHING (MAX2)*	▪ *SUCROSE SYNTHASE (SUS)*
▪ *BRANCHED (BRC1)*	▪ *STARCH SYNTHASE (SS)*
▪ *DORMANCY ASSOCIATED MADS-BOX (DAM)*	▪ *INVERTASE (INV)*
▪ *DORMANCY-ASSOCIATED-GENE-1 (DRM1)*	
▪ ABA related	
▪ GA related	

3. Genome-Wide expression profiling (RNAseq)

✓ Reconstruction of gene networks involved in dormancy induction and release.
✓ Identification of master genes controlling dormancy induction and release.

4. Function validation through perturbation of the system

✓ Hormonal treatment: ABA, fluridone, GA, Ethylene
✓ Chemical treatments: Hydrogen Cyanamide, Trichostatin A (TSA)

Figure 3. Research plan divided in four stages. Stage 1 has been completed and stage 2 will start in November 2013.

Conclusions

- Lily artificial propagation through bulb-scale culture "scaling" provides an efficient system to study dormancy related processes in flower bulbs.
- In this system dormancy induction takes place gradually after six weeks of culture.
- During dormancy induction the bulblets can produce leaves but do not increase significantly in size.
- Dormancy release requires a cold storage treatment (4°C) of minimum eight weeks and this is probably linked to sugars remobilization and ABA/GA interplay.

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