

## Two florigens and a florigen-like protein form a triple regulatory module at the shoot apical meristem to promote reproductive transitions in rice

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### Abstract

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Many plant species monitor and respond to changes in day length (photoperiod) for aligning reproduction with a favourable season. Day length is measured in leaves and, when appropriate, leads to the production of floral stimuli called florigens that are transmitted to the shoot apical meristem to initiate inflorescence development<sup>1</sup>. Rice possesses two florigens encoded by *HEADING DATE 3a* (*Hd3a*) and *RICE FLOWERING LOCUS T 1* (*RFT1*)<sup>2</sup>. Here we show that the arrival of *Hd3a* and *RFT1* at the shoot apical meristem activates *FLOWERING LOCUS T-LIKE 1* (*FT-L1*), encoding a florigen-like protein that shows features partially differentiating it from typical florigens. *FT-L1* potentiates the effects of *Hd3a* and *RFT1* during the conversion of the vegetative meristem into an inflorescence meristem and organizes panicle branching by imposing increasing determinacy to distal meristems. A module comprising *Hd3a*, *RFT1* and *FT-L1* thus enables the initiation and balanced progression of panicle development towards determinacy.

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### Data availability

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All data generated or analysed during this study are included in this Letter (and its supplementary files). The 3D protein structure of FT-L1 was modelled on the basis of available structural data on monomeric AtFT (PDB ID [6igh.1](#)).

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## Contributions

F.G., G.A.B., D. Martignago, Y.M., G.V., T.T., M.C., D.C., M.B., B.K., P.M., D.G. and V.B. performed the expression analyses, generated the transgenic plants, recorded the phenotypes and analysed the data. R.W., D.K. and D. Miki designed and produced the GFP knock-in plants. W.T. and M.K. produced the Volano mutant collection. M.M. performed the field experiments. G.C., V.B., D. Miki and J.K. conceived the experiments. F.F. and F.G. conceived the project and wrote the manuscript.

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## Ethics declarations

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Competing interests

The authors declare no competing interests.

## Peer review

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## **Supplementary information**

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### **[Supplementary Information](#)**

Supplementary Figs. 1–9.

### **[Reporting Summary](#)**

### **[Supplementary Table 1](#)**

Pearson correlation coefficients among gene transcripts (*FT-L1* versus 728 Affymetrix rice microarrays). Genes indicated in red have been demonstrated to regulate aspects of reproductive (mostly floral) development.

### **[Supplementary Data 1](#)**

Statistical source data.

### **[Supplementary Data 2](#)**

Unprocessed western blots.

### **[Supplementary Data 3](#)**

Primers used in this study.

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