

Thomas B. Jacobs

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Lab Websites: https://www.psb.ugent.be/groups/plant_genome_editing

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Research interests

My lab is interested in the development and optimization of genome editing tools and synthetic biology in plants. We generate easy-to-use systems and protocols and make these widely available to the research community. I am establishing new lines of research to discover genome-wide genetic interactions and enable megabase-scale genome engineering projects in plants.

Education

2009-2014	University of Georgia	PhD Plant Breeding, Genetics and Genomics
2004-2008	University of Connecticut	BSc Horticulture
2004-2008	University of Connecticut	BSc Molecular and Cellular Biology

Work history

2022-	100% Associate Professor, Ghent University, Belgium
2016-	VIB Group Leader, VIB-UGent Center for Plant Systems Biology, Belgium
2014-2016	Postdoctoral Scientist, Boyce Thompson Institute for Plant Research, New York, USA
2009-2014	Research Assistant, University of Georgia, Georgia, USA
2008-2009	Technician, Agrivida Inc., Storrs, CT

Grants and fellowships

2023	FWO senior onderzoeksproject G015623N (co-promoter)— How Ulva blooms, unravelling the genetic architecture of green tides
	FWO PhD Fellowship 1SHGX24N awarded to Elke Vereecke (promoter)
2022	ERC Starting Grant 101043132: Developing technologies to engineer plant genomes at the megabase scale: OMEGA
2020	FWO PhD Fellowship 1SE2521N awarded to Ward Develtere (promoter)
2019	VLAIO Research Project: Development of gRNA design and base editing tools for wheat HBC.2018.2152
2016	NSF Postdoctoral Research Fellowship in Biology, withdrawn – funded elsewhere

Publications

Peer-reviewed publications and pre-prints

32. Cautereels, C., Smets, J., De Saeger, J., Cool, L., Zhu, Y., Zimmermann, A., Steensels, J., Gorkovkiy, A., Jacobs, T.B., Verstrepen, K. (2024). Orthogonal LoxPsym sites allow multiplexed site-specific recombination in prokaryotic and eukaryotic hosts. *Nat. Comm* (in press)
31. Develtere, W., Decaestecker, W., Rombaut, D., Anders, C., Clicque, E., Vuylsteke, M., and **Jacobs, T.B.** (2023). Continual improvement of multiplex mutagenesis in *Arabidopsis*. *bioRxiv* 2023.12.19.572307
30. Zhu, S., Pan, L., Vu, L.D., Xu, X., Orosa-Puente, B., Zhu, T., Neyt, P., van de Cotte, B., **Jacobs, T.B.**, Gendron, J.M., Spoel, S.H., Gevaert, K. and De Smet, I. (2024). Phosphoproteome analyses pinpoint the F-box protein SLOW MOTION as a regulator of warm temperature-mediated hypocotyl growth in *Arabidopsis*. *New Phytol*, 241: 687-702.
29. Impens, L., Lorenzo, C.D., Vandeputte, W., Wytynck, P., Debray, K., Haeghebaert, J., Herwegh, D., **Jacobs, T.B.**, Ruttink, T., Nelissen, H., Inzé, D. and Pauwels, L. (2023). Combining multiplex gene editing and doubled haploid technology in maize. *New Phytol*, 239: 1521-1532.
28. Blomme, J., Wichard, T., **Jacobs, T. B.**, & De Clerck, O. (2023). *Ulva*: An emerging green seaweed model for systems biology. *Journal of Phycology*, 59, 433–440.
27. De Bruyn C, Ruttink T, Lacchini E, Rombauts S, Haegeman A, De Keyser E, Van Poucke C, Desmet S, **Jacobs TB**, Eeckhout T, Goossens A, Van Laere K. (2023). Identification and characterization of CYP71 subclade cytochrome P450 enzymes involved in the biosynthesis of bitterness compounds in *Cichorium intybus*. *Front Plant Sci*. 14:1200253.
26. Lorenzo C.D., Debray K., Herwegh D., Develtere W., Impens L., Schaumont D., Vandeputte W., Aesaert S., Coussens G., de Boe Y., Demuyne K., Van Hautegeem T., Pauwels L., **Jacobs T.B.**, Ruttink T., Nelissen H., Inzé D. (2023). BREEDIT: A novel multiplex genome editing strategy to improve complex quantitative traits in maize (*Zea mays* L.) *Plant Cell* 35, 218-238.
25. Develtere W., Waegneer E., Debray K., Van Glabeke S., Maere S., Ruttink T., **Jacobs T.B.*** (2023). SMAP design: A multiplex PCR amplicon and gRNA design tool to screen for natural and CRISPR-induced genetic variation. *Nucleic Acids Research* 51 (7), e37.
24. Gaillochet C., Pena Fernandez A., Goossens V., D'Halluin K., Drozdzecki A., Shafie M., Van Duyse J., Van Isterdael G., Gonzalez C., Vermeersch M., De Saeger J., Develtere W., Audenaert D., De Vleeschauwer D., Meulewaeter F., **Jacobs T.B.*** (2023). Systematic optimization of Cas12a base editors in wheat and maize using the ITER platform. *Genome Biology* 24 (1).
23. Aesaert S, Impens L, Coussens G, Van Lerberge E, Vanderhaeghen R, Desmet L, Vanhevel Y, Bossuyt S, Wambua AN, Van Lijsebettens M, Inzé D, De Keyser E, **Jacobs T.B.**, Karimi M, Pauwels L. (2022) Optimized Transformation and Gene Editing of the B104 Public Maize Inbred by Improved Tissue Culture and Use of Morphogenic Regulators. *Front Plant Sci*. 22;13:883847.
22. De Saeger J., Vermeersch M., Gaillochet C., **Jacobs T.B.*** (2022) Simple and Efficient Modification of Golden Gate Design Standards and Parts Using Oligo Stitching. *ACS Synthetic Biology* 11 (6), 2214-2220.
21. Blomme J., Develtere W., Köse A., Arraiza Ribera J., Brugmans C., Jaraba-Wallace J., Decaestecker W., Rombaut D., Baekelandt A., Fernández Fernández A., Van Breusegem F., Inzé D. and **Jacobs T.B.*** (2022). The Heat Is on: a Simple Method to Increase Genome Editing Efficiency in Plants, *BMC Plant Biol* 22, 142.
20. Zhang C., Lauster T., Tang W., Houbaert A., Zhu S., Eeckhout D., De Smet I., De Jaeger G., **Jacobs T.B.**, Xu T., Müller S. and Russinova E.* (2022). ROPGAP-dependent interaction between brassinosteroid and ROP2-GTPase signaling controls pavement cell shape in *Arabidopsis*. *Curr. Biol*. 32, 518-531.
19. Impens L., **Jacobs T.B.**, Nelissen H., Inzé D. & Pauwels L. (2022). Mini-Review: Transgenerational CRISPR/Cas9 Gene Editing in Plants. *Frontiers in Genome Editing* 4, 825042.

18. Kashkan I., Hrtyan M., Retzer K., Humpolíčková J., Jayasree A., Filepová R., Vondráková Z., Simon S., Rombaut D., **Jacobs T.B.**, Frilander M.J., Hejátko J., Friml J., Petrášek J. and Růžicka K.* (2022). Mutually opposing activity of PIN7 splicing isoforms is required for auxin-mediated tropic responses in *Arabidopsis thaliana*. *New Phytol.* 233, 329-343.
17. Pfeiffer M.L., Winkler J., Van Damme D., **Jacobs T.B.*** and Nowack M.K.* (2022). Conditional and tissue-specific approaches to dissect essential mechanisms in plant development. *Curr. Opin. Plant Biol.* 65, 102119.
16. Blomme J., Liu X., **Jacobs T.B.** and De Clerck O. * (2021). A molecular toolkit for the green seaweed *Ulva mutabilis*. *Plant Physiol.*, 186, 1442-1454.
15. Bollier N., Andrade Buono R., **Jacobs T.B.*** and Nowack M.K.* (2020). Efficient simultaneous mutagenesis of multiple genes in specific plant tissues by multiplex CRISPR. *Plant Biotechnol. J.*, 19, 651-653.
14. Gaillochet C., Develtere W. and **Jacobs T.B.*** (2021). CRISPR screens in plants: approaches, guidelines and future prospects. *Plant Cell*, 33, 794-813.
13. Rodrigues S.D., Karimi M., Impens L., Van Lerberge E., Coussens G., Aesaert S., Rombaut D., Holtappels D., Ibrahim H.M.M., Van Montagu M.*, Wagemans J., **Jacobs T.B.**, De Coninck B.* and Pauwels L.* (2021). Efficient CRISPR-mediated base editing in *Agrobacterium* spp. *Proc. Natl. Acad. Sci. USA* 118, e2013338118.
12. De Bruyn C., Ruttink T., Eeckhaut T., **Jacobs T.B.**, De Keyser E., Goossens A. and Van Laere K.* (2020). Establishment of CRISPR/Cas9 genome editing in witloof (*Cichorium intybus* var. *foliosum*). *Frontiers in Genome Editing* 2, 604876.
11. Decaestecker W.°, Andrade Buono R.°, Pfeiffer M.L., Vangheluwe N., Jourquin J., Karimi M., Van Isterdael G., Beeckman T., Nowack M.K.* and **Jacobs T.B.*** (2019). CRISPR-TSKO: a technique for efficient mutagenesis in specific cell types, tissues, or organs in *Arabidopsis*. *Plant Cell* 31, 2868-2887.
10. Hu Z., Zhang T., Rombaut D., Decaestecker W., Xing A., D'Haeyer S., Höfer R., Vercauteren I., Karimi M., **Jacobs T.B.** and De Veylder L.* (2019). Genome editing-based engineering of CESA3 dual-cellulose-inhibitor-resistant plants. *Plant Physiol.* 180, 827-836.
9. Smet W.°, Seville I.°, de Luis Balaguer M.A., Wybouw B., Mor E., Miyashima S., Blob B., Roszak P., **Jacobs T.B.**, Boekschoten M., Hooiveld G., Sozzani R., Helariutta Y. and De Rybel B.* (2019). DOF2.1 controls cytokinin-dependent vascular cell proliferation downstream of TMO5/LHW. *Curr. Biol.* 29, 520-529.
8. Houbaert A., Zhang C., Tiwari M., Wang K., de Marcos Serrano A., Savatin D.V., Urs M.J., Zhiponova M.K., Gudesblat G.E., Vanhoutte I., Eeckhout D., Boeren S., Karimi M., Betti C., **Jacobs T.**, Fenoll C., Mena M., de Vries S., De Jaeger G. and Russinova E.* (2018). POLAR-guided signalling complex assembly and localization drive asymmetric cell division. *Nature* 563, 574-578.
7. **Jacobs T.B.***, Zhang N., Patel D. and Martin G.B.* (2017). Generation of a collection of mutant tomato lines using pooled CRISPR libraries. *Plant Physiol.* 174, 2023-2037.
6. **Jacobs T.B.** and Martin G.B. (2016). High-throughput CRISPR vector construction and characterization of DNA modifications by generation of tomato hairy roots. *J. Vis. Exp.* 110, e53843.
5. **Jacobs T.B.***, Lawler N.J., LaFayette P.R., Vodkin L.O. and Parrott W.A. (2016). Simple gene silencing using the trans-acting siRNA pathway. *Plant Biotechnol. J.* 14, 117-127.
4. Kanizay L., **Jacobs T.** and Hancock C.N.* (2016). A transgenic, visual screenable marker for soybean seeds. *Transgenic Res.* 25, 187-193.
3. Zhou X.°, **Jacobs T.B.°**, Xue L.-J., Harding S.A. and Tsai C.-J.* (2015). Exploiting SNPs for biallelic CRISPR mutations in the outcrossing woody perennial *Populus* reveals 4-coumarate:CoA ligase specificity and redundancy. *New Phytol.* 208, 298-301.

2. **Jacobs T.B.***, LaFayette P.R., Schmitz R.J. and Parrott W.A. (2015). Targeted genome modifications in soybean with CRISPR/Cas9. *BMC Biotechnol.* 15, 16.
1. Kanizay L.B.*, **Jacobs T.B.**, Gillespie K., Newsome J.A., Spaid B.N. and Parrott W.A. (2015). HtStuf: Highthroughput sequencing to locate unknown DNA junction fragments. *Plant Genome* 8, doi:10.3835/plantgenome2014.10.0070.

Book chapters

3. Blomme, J., Arraiza Ribera, J., Develtere, W., & **Jacobs, T. B.** (2022). A simple and low-tech heat-shock method to increase genome editing efficiency in plants. *Current Protocols*, 2, e608.
2. Decaestecker W., Bollier N., Buono R., Nowack M.K., **Jacobs T.B.*** (2022). Protoplast Preparation and Fluorescence-activated Cell Sorting for the Evaluation of Targeted Mutagenesis in Plant Cells. In *Protoplast Technology: Methods and Protocols, Methods in Molecular Biology*, Vol. 2464. Kan Wang & Feng Zhang (Eds.). New York Humana Press. pp. 205-221 (doi.org/10.1007/978-1-0716-2164-6_15) [ISBN 978-1-0716-2164-6]
1. Swinnen G., **Jacobs T.**, Pauwels J. and Goossens A.* (2020). CRISPR-CAS-mediated gene knockout in tomato. In *Plant and Food Carotenoids, Methods in Molecular Biology*, Vol. 2083, M. Rodríguez Concepción & R. Welsch (Eds.). New York, Humana Press, pp. 321-341 (doi:10.1007/978-1-4939-9952-1_25) [ISBN978-1-4939-9951-4].

Other Publications

2. Karimi M. and **Jacobs T.B.*** (2020). GoldenGateway: a DNA assembly method for plant biotechnology. *Trends in Plant Sci.*, first published on 4/11/2020 (doi: 10.1016/j.tplants.2020.10.004).
1. Annabi, N., Baker, M., Boettiger, A. et al. Voices of biotech research. *Nat Biotechnol* 39, 281–286 (2021).
<https://doi.org/10.1038/s41587-021-00847-1>

Patent Applications

1. **Jacobs T.B.**, Parrott W.A. and Vodkin L.O. (2012). Compositions and methods of gene silencing in plants. Application number US 14/559,209, filed Dec 3, 2014.

Editor and Reviewer Activities

2021-now	Associate Editor, <i>The Plant Genome</i>
2020-now	Associate Editor, <i>Plant Biotechnology Journal</i>

Manuscript reviewer: *Nature Biotechnology*, *Current Opinion in Plant Biology*, *Frontiers in Plant Science*, *Journal of Integrative Agriculture*, *Legumes*, *Molecular Plant Pathology*, *Plant Cell Reports*, *Plant Biotechnology Journal*, *Plant Molecular Biology*, *PlantPhys*, *Plant Methods*, *PLOSone*, *Scientific Reports*, and *The Plant Journal*

Grant reviewer: BARD, Crop Plants for the Future BMBF, DGAPF (Belgian Federal

Service for Health, Food Chain Safety and Environment), NSF, ERC

Professional committees and organizations

2025	Organizing committee for ICAR 2025
2024	Co-organizer PAG31 workshop “Scaling Up: New Frontiers in Large-scale Plant Genome Engineering”
2021	5th International Conference on Plant Synthetic Biology
2021	VIB Genome Engineering and Synthetic Biology, Gent, Belgium,
2019-2023	VIB Tech Watch Committee
2018	VIB Genome Engineering and Synthetic Biology, Brugge, Belgium

Industrial Activities

2024-now	Scientific Advisor, Bayer Crop Science
2021-2024	Scientific Advisor, Inari Agriculture Inc.
2020-2021	Scientific Advisor, Bolthouse Farms Inc.

Students

Postdoc:	Christophe Gaillochet (Phytoform), Jonas Bloome (current), Jonas De Saeger (UGent-Korea), Ellen Slaman (current), Silvia Trogu (current)
PhD:	Ward Develtere (current), Julia Arraiza Ribera (current), Elke Vereecke (current), Emma Vandelannootte (current, co-promoter), Ania Lukasiewicz (graduated 2023), Marie Pfeiffer (graduated 2023, co-promoter), Ward Decaestecker (graduated 2021)
Masters2:	Julia Benet i Ferre (current) Bram Vonck (2022), Ward Develtere (2019), Christophe Brugmans (2018)
Masters1:	Pieter Laureys (2022), Matthias Haelterman (2022), Annelies Vansoye (2022), Rim Kaspar (2021), Aaron Zipperle (2021), Gawein Van den Abbeele (2020), Angela Debruyne (2020), Marieke Carels (2020), Jordan Martin (2019), Elke Clicque (2018), Christophe Brugmans (2017)
Erasmus:	Jose Antonio Saavedra Herrera (2022), Nuria Canal (2021), Camila Gonzales (2021), Júlia Arraiza (2019), Ayşe Köse (2018), Jessica Jaraba (2017)
Hogeschool:	Willem De Bisschop (2022) Sven De Rudder (2020)
iGEM	iGEM KU Leuven (2021)

PhD committee member

Fien Lanssens, Ghent University, Faculty of Sciences, 2023
Fei Xie (secretary), Ghent University, Faculty of Sciences, 2023
Jian Chen, Ghent University, Faculty of Sciences, 2022
Lana Hellebaut, Ghent University, Faculty of Sciences, 2022
Jonas De Saeger, Ghent University, Faculty of Sciences, 2021
Pan Gong, Ghent University, Faculty of Sciences, 2021
Lennart Hoengenaert (secretary), Ghent University, Faculty of Sciences, 2020

Nick Vangheluwe, Ghent University, Faculty of Sciences, 2020
Robin Vanluchene (secretary), Ghent University, Faculty of Sciences, 2020
John Odipio (secretary), Ghent University, Faculty of Sciences, 2020
Lisanne de Vries, Ghent University, Faculty of Sciences, 2019
Katlyn Borgers, Ghent University, Faculty of Sciences, 2019
Brecht De Paepe, Ghent University, Faculty of Bioscience Engineering, 2018
Zhen Gao (secretary), Ghent University, Faculty of Sciences, 2016

PhD guiding committee

Roman (UGent; 2016-), Renqiang Li (KULeuven; 2021-), Diana Katherine Castillo Avila (Inland Norway University; 2024)

Teaching

Courses given

Ghent University, Moleculaire Biologie van Planten (C003377), 2024-now
VIB Introductory Genome Engineering Workshop, 2016-now

Invited lecturer

NOVA PhD course in Plant Breeding, Tvärminne, Finland, 2024
Summer Institute in Plant Breeding, Gent, 2023
eCOST PlantEd Training School, Dusseldorf, 2022
Organismal Biology, SLU, 2021
Ghent University, The Plant Factory (C00310), 2017-2023
VIVES, Dept. HIVB, Cloning, 2017, 2018, 2020
Ghent University, IPBO, Biosafety in Plant biotechnology 2017
Ghent University, IPBO, Modern breeding techniques for potato improvement, 2018

Training

Ghent University Introductory Teacher Training course, 2019

Presentations

Invited speaker

2024 Genome Engineering: Research and Applications, Rome, IT
2023 Agricultural Science Policy Breakfast, EU Parliament, Brussels, BE
PlantGENE workshop, online
ICAR 2023, Chiba, Japan
Bayer, BE
PSI, NCSU, USA
Plant and Animal Genome 30, CA, USA
2022 RDP, ENS Lyon, France
eCOST 3rd PlantEd Conference, Dusseldorf
International Conference On Arabidopsis Research 2022, Belfast, IR
Plant and Animal Genome XXIX, CA, USA
2021 IP Protection for Plant Innovation (webinar)

- University of Minnesota's Center for Precision Plant Genomics (webinar)
- Hands-on training on CRISPR/Cas9 mediated Gene-editing in plants, Dept. of Plant Sciences, University of Hyderabad, India (webinar)
- German Association for the Protection of Intellectual Property (GRUR) Annual meeting (webinar)
- Masterclasses in Crop Transformation for Genome Editing (webinar)
- Plantae Presents webinar series
- Iowa State University Crop Bioengineering (webinar)
- 2020 Keystone Symposia on Plant Genome Engineering, CO, USA
- 2019 American Society for Plant Biology, CA, USA
- 2018 Agrobacterium 2018, Gent, Belgium
- International PhD School of Plant Development, Retzbach, Germany
- 2017 Plant and Animal Genome XXV, CA, USA
- VI Brazilian Symposium on Plant Molecular Genetics, Ouro Preto, Brazil
- International Organization for Biological and Integrated Control, Gent, Belgium
- R&D of Agri Products, Amsterdam, The Netherlands
- 2016 Plant and Animal Genome XXIV, CA, USA
- VIB Courses, CRISPR-based Genome Engineering
- 2015 Soybean Precision Genomics and Mutant Finder
- Iowa Crop Bioengineering Consortium Conference: Genome Editing: Foundations and Applications
- 2014 Molecular Cellular Biology of the Soybean Biennial Conference
- 2013 USC Aiken Fall Biology Seminar Series
- 2012 The Society for In Vitro Biology Meeting, WA, USA