

# Deep Frontier

'Challenging one last frontier: Understanding and improving deep rooting'

## Publication and Dissemination List

### Scientific Communication

#### Papers

- Han, E.; Dresbøll, D.B.; and Thorup-Kristensen, K. (submitted 2019 – Plant and Soil). Core-labelling technique (CLT): A novel combination of the ingrowth-core method and tracer technique for deep root study (2020). *Plant Methods*, 16 (1), p. 84. <https://orgprints.org/38136/>
- Hassan AB, Dresbøll DB, Rasmussen CR, Lyhne-Kjærbye A, Nicolaisen MH, Stokholm MS, Lund OS, Thorup-Kristensen, K. (2019). Root distribution in intercropping systems – a comparison of DNA based methods and visual distinction of roots. *Archives of Agronomy and Soil Science*.
- Liang, Zhi; Olesen, Jørgen E.; Jensen, Johannes L. and Elsgaard, Lars (2018). Nutrient availability affects carbon turnover and microbial physiology differently in topsoil and subsoil under a temperate grassland. *Geoderma*, 336, pp. 22-30. <http://orgprints.org/33793/>
- Liang, Zhi; Elsgaard, Lars; Nicolaisen, Mette H.; Lyhne-Kjærbye, Annemette and Olesen, Jørgen E. (2018). Carbon mineralization and microbial activity in agricultural topsoil and subsoil as regulated by root nitrogen and recalcitrant carbon concentrations. *Plant and Soil*, pp. 1-18. <http://orgprints.org/33966/>
- Liang, Zhi; Olesen, Jørgen E.; Nørgaard, Trine; and Elsgaard, Lars. (2019). Extraction and enzymatic assay of glucose in soils with divergent pH, clay and organic carbon contents. *Communications in Soil Science and Plant Analysis* <https://orgprints.org/37962/>
- Peixoto, Leanne; Elsgaard, Lars; Rasmussen, Jim; Kuzyakov, Yakov; Banfield, Callum C.; Dippold, Michaela A.; and Olesen, Jørgen E. (submitted 21/04/2020 – Global change Biology). Carbon input, microbial utilization and stabilization by deep-rooted crops to 3.6 meter depth.
- Peixoto, Leanne; Elsgaard, Lars; Rasmussen, Jim; and Olesen, Jørgen E. (submitted 23/04/2020 – The European Journal of Soil Science). Nitrogen and phosphorus co-limits mineralization of added carbon in deep subsoil.
- Rasmussen, Camilla Ruø; Thorup-Kristensen, Kristian; Dresbøll, Dorte Bodin. (2019). Uptake of subsoil water below 2 m fails to alleviate drought response in deep-rooted Chicory (*Cichorium intybus* L.). *Plant and Soil*.
- Rasmussen, Camilla Ruø; Thorup-Kristensen, Kristian; Dresbøll, Dorte Bodin. (2020). The effect of drought and intercropping on chicory nutrient uptake from below 2 m studied in a multiple tracer setup. *Plant Soil* 446, 543–561
- Smith, Abraham Georg; Petersen, J.; Selvan, R.; and Ramussen, C.R. (2020) Segmentation of roots in soil with U-net. *Plant Methods* 16
- Smith, Abraham Georg; Han, E.; Petersen, J.; Olsen, N.A.F.; Giese, C.; Athmann, M.; Dresbøll, D. B.; and Thorup-Kristensen, K. (2020) RootPainter: Deep Learning Segmentation of Biological Images with Corrective Annotation. *bioRxiv* doi: <https://doi.org/10.1101/2020.04.16.044461>
- Thorup-Kristensen, Kristian; Halberg, N.; Nicolaisen, M.; Olesen, J.E.; Crews, T.; Hinsinger, P.; Kirkegaard, J.A.; Pierret, A.; and Dresbøll, D.B. (2020) Digging deeper for agricultural resources, the value of deep tooting. *Trends in Plant Science*. [https://www.cell.com/trends/plant-science/pdf/S1360-1385\(19\)30332-2.pdf](https://www.cell.com/trends/plant-science/pdf/S1360-1385(19)30332-2.pdf);

Thorup-Kristensen, Kristian; Halberg, N.; Nicolaisen, M.; Olesen, J.E.; and Dresbøll, D.B. (2020). Exposing Deep Roots: A Rhizobox Laboratory. *Trends in Plant Science*, Technology of the Month. <https://www.cell.com/action/showPdf?pii=S1360-1385%2819%2930331-0>

### Presentations

- Dresbøll, Dorte Bodin (2017). Rodudviklingens betydning for planternes forsyning med vand og næringsstoffer. [The importance of root development for plant water and nutrient uptake.] Speech at: Plantekongres, Herning kongrescenter, 17-18 januar 2017 <http://orgprints.org/32132/>
- Dresbøll, Dorte Bodin (2019). Root growth and deep water uptake of 3 perennial crops. At: Is the future of agriculture perennial? Lund, May 2019
- Han, Eusun (2016). The hidden half of the plants for 'deep-rooted' organic agriculture: IFOAM Asia Organic Youth Forum, The First Farm, Changzhou, China, 28 October 2018 <https://orgprints.org/36655/>
- Han, Eusun; Havmøller, Lisa; Dresbøll, Dorte Bodin; and Thorup-Kristensen, Kristian (2017). Identification of deep-rooting crop species in arable subsoil by the minirhizotron technique. Scientific Conference "Innovative Research for Organic 3.0 at the 19<sup>th</sup> Organic World Congress organized by ISOFAR/OFAI/TIPI, November 2017, New Dehli, India <https://orgprints.org/36656/>
- Rasmussen, Camilla Ruø; Dresbøll, Dorte Bodin; and Thorup-Kristensen, Kristian (2019) Chicory acquires water from below 2 m depth – but is still hit by topsoil drought, European geoscience Union General Assembly, Vienna, Austria, 7–12 April 2019.
- Thorup-Kristensen, Kristian (2019). Deep nutrient uptake by Kernza and Silphium studied by tracer uptake. At: Is the future of agriculture perennial? Lund, May 2019

### Posters

- Czaban, Weronika; Clement, Corentin; Han, Eusun; Dresbøll, Dorte Bodin; and Thorup-Kristensen, Kristian (2018). The effect of Intercropping on the Deep Root Development and Nutrient Uptake in a Sugar Beet – Chicory Mixture. 10th symposium for the international society of root research, July 2018, Tel Aviv, Israel <http://orgprints.org/33979/>
- Dresbøll, Dorte Bodin; Camilla Ruø Rasmussen, Kristian Thorup-Kristensen (2018). Capacity of Deep Rooted Species to Take Up Water and Nutrients from Deep Soil Layers. 10th symposium for the international society of root research, July 2018, Tel Aviv, Israel <http://orgprints.org/34364/>
- Han, Eusun; Dorte Bodin Dresbøll; and Kristian Thorup-Kristensen (2018). Determining deep root activity in arable fields by the core-labelling technique (CLT). 10th symposium for the international society of root research, July 2018, Tel Aviv, Israel <http://orgprints.org/33942/>
- Liang, Zhi; Lars Elsgaard; and Jørgen E. Olesen (2017). Effect of root litter quality on carbon turnover and soil microbiology in topsoil and subsoil horizons <http://orgprints.org/32133/>
- Peixoto, Leanne; Elsgaard, Lars; Rasmussen, Jim; and Olesen, Jørgen E. (2019). N and P co-limitation of carbon turnover in a clayey loam very deep subsoil. 7<sup>th</sup> International Symposium on Soil Organic Matter, Adelaide, South Australia, 6-11 October 2019.
- Rasmussen, Camilla Ruø; Dorte Bodin Dresbøll; and Kristian Thorup-Kristensen (2018). Chicory Grows Roots Below 3 m Is That Beneficial under Water Stress? 10th symposium for the international society of root research, July 2018, Tel Aviv, Israel <http://orgprints.org/34370/>

### Other scientific contributions

- Liang, Zhi (2019). Organic carbon mineralization and microbiology in subsoil. PhD thesis <https://orgprints.org/37963/>
- Rasmussen, Camilla Ruø (2019). Exploring the depths, Uncovering the contribution of deep water and nutrient uptake by chicory. PhD thesis
- Sleidrink, Joost, (2020). The role of the deep roots of perennial cereal Kernza in a drying climate. MSc thesis. <https://orgprints.org/37931/>

## Popular Communication

### Public media features

- P1 Morgen (10 August 2018): <https://www.dr.dk/radio/p1/p1-morgen/p1-morgen-2018-10-08>  
(from approximately 1 hour and 19 minutes into the programme)
- TV2 News (5 July 2018): Interview with Kristian Thorup-Kristensen
- Inför höstbruket 2018: Danmark expanderar sitt lantbruk på djupet (Väderstedt magasin (July 2018): Interview with Kristian Thorup-Kristensen)
- Kan et par rødder i Tåstrup sikre dansk landbrugs fremtid (Politiken, 10. juni 2018)  
<https://politiken.dk/viden/Viden/art6566032/Kan-et-par-r%C3%B8dder-i-Tastrup-sikre-dansk-landbrugs-fremtid>
- Rodforskning åbner for nye muligheder i landbruget (August 2017, Agro) <http://www.agrar-plus.dk/agro/artikel/96040-rodforskning-abner-op-for-nye-muligheder-i-landbruget>
- Fremtidens afgrøder skal hente bedre vækst dybere nede (Effektivt Landbrug, 27. juni 2017)
- Landbrug i dybden (Weekendavisen, 16 June 2017)
- Forskere i røddernes verden – i fire meter høje urtepotter (Dagbladet Høje-Tåstrup Ishøj, 16. juni 2017)
- Forskere i røddernes verden – i fire meter høje urtepotter (Lokalavisen Tåstrup, 20. juni 2017)
- Kæmpe urtepotter skal sikre fremtidens fødevarer: Kom med forskerne i dybden (Sjællandske Medier On-line, 16. juni 2017)
- Den underjordiske verden synliggøres under forskning i rodudvikling (PLENnews, December 2016 - <http://plen.ku.dk/nyheder/nyheder-2016/den-underjordiske-verden-synliggøres-under-forskning-i-rodudvikling/>)
- Rødder skal vinde de næste merudbytter (Økologi & Erhverv, 17. juni 2016)
- Ti cm rod giver 3hkg mere pr. hektar (Landbrugsavisen, 17. juni 2016)

### Articles by Deep Frontier

- Microbial activity in deep-rooted crops – what goes on down there? (PhD Annemette Lyhne-Kjærbye, KU) (ICROFS webnews 04.05.2020/ICROFS News May 2020)  
<https://projects.au.dk/deepfrontier/news/show/artikel/microbial-activity-in-deep-rooted-crops-what-goes-on-down-there/>  
<https://mailchi.mp/95003af78fe2/news-from-icrofs>
- Førende eksperter inden for rodforskning samlet i København (ICROFS webnyhed 27.11.2019/ICROFS Nyt, December 2019)  
<https://icrofs.dk/aktuelt/nyheder/nyhed/artikel/foerende-eksperter-inden-for-rodforskning-samlet-i-koebenhavn/>  
<https://mailchi.mp/77f732591ee9/icrofs-nyt-december-2019>
- Dybe rødder hjælper afgrøder med at overleve – men ikke nødvendigvis med at trives (PhD Camilla Ruø Rasmussen), (ICROFS webnyhed - Dansk – 12.08.2019/ICROFS Nyt, maj 2020)  
<http://icrofs.dk/aktuelt/nyheder/nyhed/artikel/dybe-roedder-hjaelper-afgroeder-med-at-overleve-men-ikke-noedvendigvis-med-at-trives/>  
<https://mailchi.mp/d7bbb5f7d86c/icrofs-nyt>
- Deep roots help crops to survive – but not necessarily to thrive (PhD Camilla Ruø Rasmussen) (ICROFS Web News - English – 22.07.2019/ICROFS Newsletter, November 2019)  
<http://projects.au.dk/deepfrontier/news/show/artikel/deep-roots-help-crops-to-survive-but-not-necessarily-to-thrive/>  
<https://mailchi.mp/5825e8b640a6/news-from-icrofs-may-1528941>
- Root litter chemistry and soil nutrient availability affect subsoil carbon turnover (Deep Frontiers website - 04.12.18 and ICROFS newsletter - 20.12.2018)

<http://projects.au.dk/deepfrontier/news/show/artikel/root-litter-chemistry-and-soil-nutrient-availability-affect-subsoil-carbon-turnover/>

Gå i dybden med rødderne på Rodens Dag d. 4. juni (ICROFS web-nyheder – 15.05.2018)

<http://icrofs.dk/aktuelt/nyheder/nyhed/artikel/gaa-i-dybden-med-roedderne-paa-rodens-dag-d-4-juni/>

Promising results about carbon turnover in deep soil (ICROFS Newsletter – 29.09.2017)

<http://projects.au.dk/deepfrontier/news/show/artikel/promising-results-about-carbon-turnover-in-deep-soil/>

Masser af viden om de dybe rødder graves frem i den kommende vækstsæson (ICROFS Newsletter – 01.02.2017)

<http://projects.au.dk/deepfrontier/news/show/artikel/masser-af-viden-om-de-dybe-roedder-graves-frem-i-den-kommende-vaekstsæson/>

Rodens dag - gå i dybden med rødderne (ICROFS web-nyheder - 02.05.2016)

<http://icrofs.dk/aktuelt/nyheder/nyhed/artikel/rodens-dag-gaa-i-dybden-med-roedderne-1/>

## Videos

Interview with Peter Gregory, Emeritus Professor, Reading University, UK, at the International Workshop 'Deep Rooted Crops for Future Food Production', 2526 November 2019,

Copenhagen, Denmark <https://projects.au.dk/deepfrontier/international-workshop-november-2019-deep-rooted-crops-for-future-food-production/>

Interview with Michael Schloter, Helmholtz Zentrum München, Germany, at the International Workshop 'Deep Rooted Crops for Future Food Production', 2526 November 2019,

Copenhagen, Denmark <https://projects.au.dk/deepfrontier/international-workshop-november-2019-deep-rooted-crops-for-future-food-production/>

Deep Rooted crop research and Agroecology (PhD student Corentin Clément, University of Copenhagen) [https://www.youtube.com/watch?v=u02fzxa\\_7XE&t=16s](https://www.youtube.com/watch?v=u02fzxa_7XE&t=16s)

Dybe Rødder og lagring af kulstof (Professor Jørgen E. Olesen, Aarhus University)

<https://www.youtube.com/watch?v=3lGOsASo3dk>

Rodbakterier i de dybe rodlag (Associate Professor Mette Haubjerg Nicolaisen, University of Copenhagen) <https://www.youtube.com/watch?v=mnNHZZSXixg>

Testafgrøder i Deep Frontier – Hvorfor teste kruset skræppe (Professor Kristian Thorup-Kristensen, University of Copenhagen)

[https://www.youtube.com/watch?time\\_continue=7&v=iLS0-APXegE](https://www.youtube.com/watch?time_continue=7&v=iLS0-APXegE)

## Other publication and dissemination activities

Joint activity between Deep Frontier/KU research group:

Instagram: <https://www.instagram.com/adeeplookbelowground/>

Facebook: <https://www.facebook.com/Adeeplookbelowground-1907797182649573/>

Twitter: <https://twitter.com/Adeeplookbelow?lang=en>

Visits at the field facilities at Højbakkegård in addition to the open field day 'Day of the Root':  
2019

Nov. 25 Participants at the International Workshop 'Deep Rooted Crops for Future Food Production', 2526 November 2019, Copenhagen, Denmark (20-25 visitors)

May 2 Ecole des Etablières, France – group of french students

May Lund University Centre for Sustainability Studies (LUCSUS) – group visit (40-50 people) in relation to a conference in Lund 6-10 May 'Is the future of agriculture perennial?' <https://www.lucsus.lu.se/article/is-the-future-of-agriculture-perennial/>

2018

- Nov. 11 15 græsfrø konsulenter fra DLF trifolium
- Nov 6 Besøg af erfagruppe af landmænd. 10 landmænd
- June-August: Student from ISA Lille (Institute of Life Science), Lille, France. Internship –Deep Frontier Field Lab.
- June 28 Besøg af konsulenter fra AgriNord
- June 27 Fremvisning ved undervisning i kursus om Planterforædling
- June 22 Plant Biology Europe 2018 conference, conference tour to DeepFrontier and other facilities
- June 22 ERFA gruppe fra Lolland Falster. 20 landmand og konsulenter
- June 21 20 konsulenter fra Vestjydske Landboforening
- June 6 Besøg fra Ingelby Farms and Forests
- June 4 Rodens Dag + møde i Udvalget for konkurrencedygtig planteproduktion
- Jan. 4 Besøg fra Norges Life Science Universitet

2017

- Dec. 4 L.E. Jackson Prof. emeritus UC Davis
- Aug. 25 International plant nutrition colloquium 2017
- July 7 Chris Topp, Donald Danforth Plant Science Center
- May Gefion Landboforening – organic crop production advisors Gefion
- Apri Section from the Department of Geosciences and Natural Resource Management, University of Copenhagen

2016

- Dec. Nordic Beet Research
- Sept. Plants in Populations, Communities and Ecosystems
- Sept. Gefion Landboforening - crop production advisors
- June FlowerNet network meeting