Robusta and RadiMax

Status 2017

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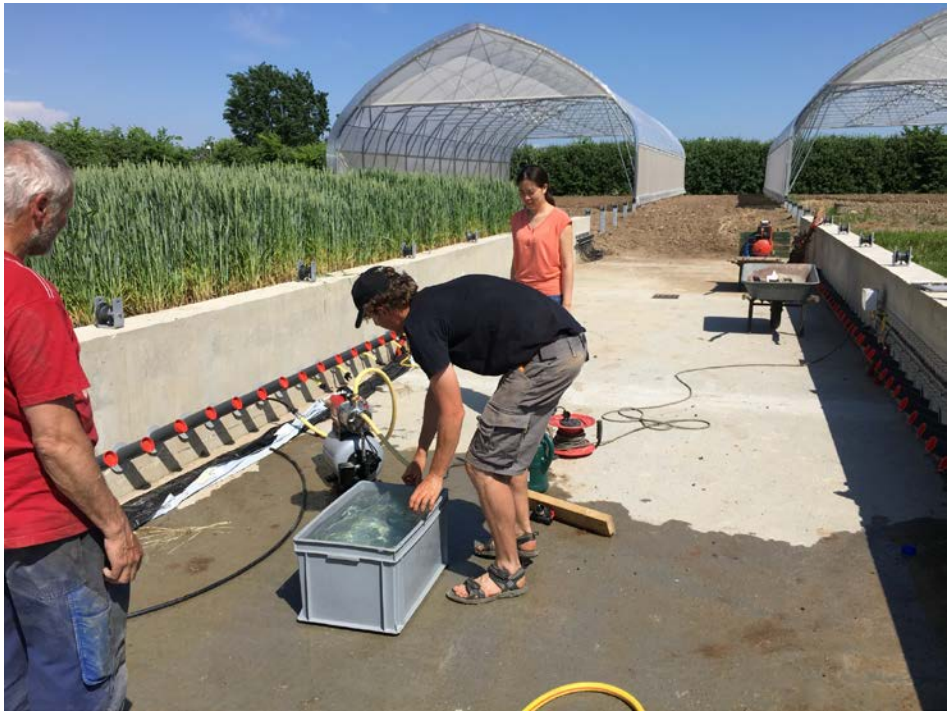
Water and nitrogen measurements in RadiMax

- ^{15}N applied in KU lines
  - 30 applications in barley
  - 15 applications in grasses
- Repeated sampling for ^{15}N along gradient in barley
  - Flag leaves after labelling
  - Grain at harvest
- ^{2}H labelled water applied in grasses
- Transpiration water sampled along gradient

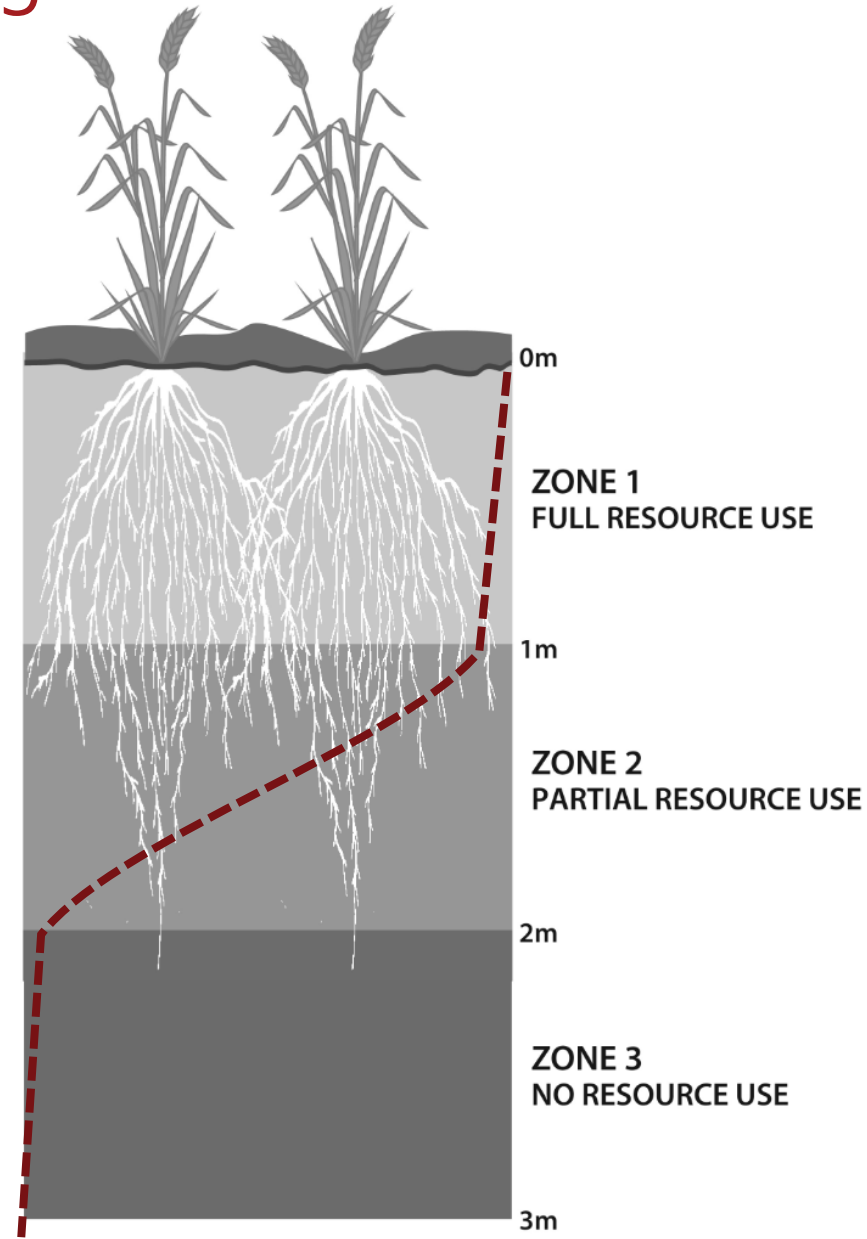
Applying isotope tracers along depth gradient



Other water and N measurements in RadiMax

- Water – gradient observed with thermal camera from drone
  - Checked against stomatal conductance measurements
  - Results confirming water gradient
- Nitrogen
  - Uptake at harvest, grain and straw in KU lines
  - N in grain in all lines

Understanding the "root zone"



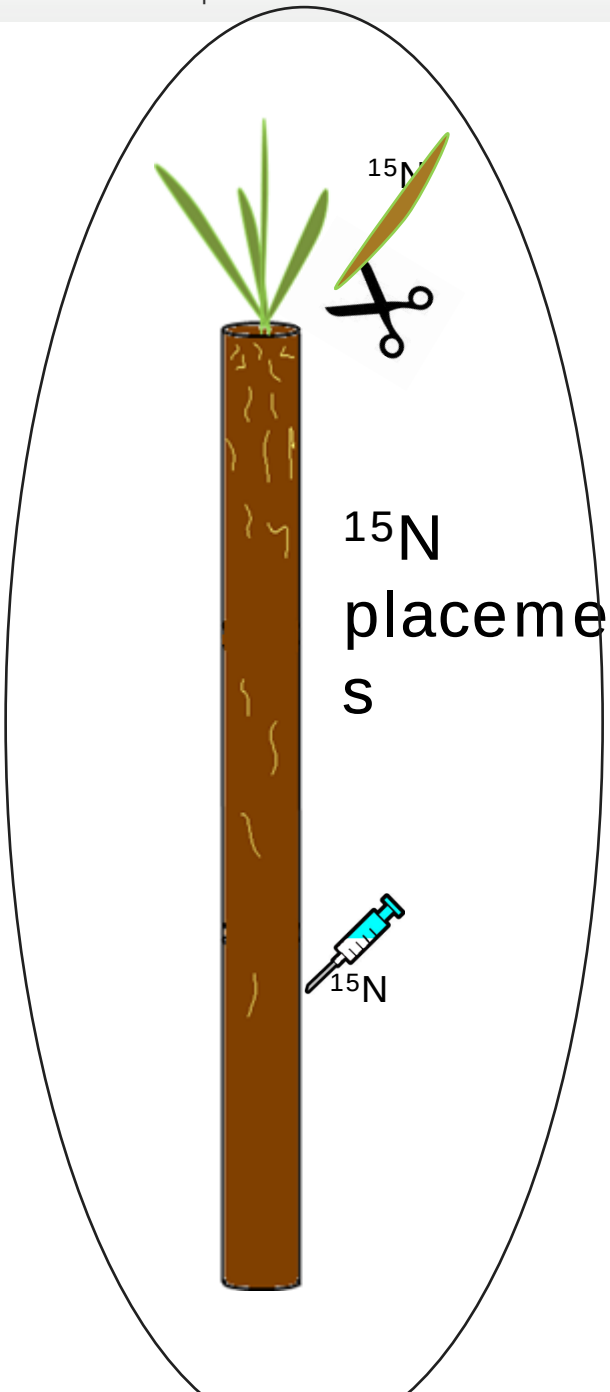
Plans for 2018

- Much of the same, with winter wheat and potato
  - Dependent on 2017 results, especially for ^{2}H water
- Drone imaging for water and biomass gradients
  - Jesper will tell about the plans for 2018 at RadiMax meeting
- General N measurements in all lines?
  - Not possible to sample earlier – will damage measurements
  - Further subdivision of lines at harvest?
  - More work, smaller samples, do we want that?

"Herbicide box" plans for 2018

- **Goal: To develop root screening methods that can be applied broadly**
- FAUPE results showed that herbicide and ^{15}N were at least as good as direct root observation

- More experiment design options as they do not require direct root observation
  - Easier to make large scale, herbicide box v.s. single tubes
  - Herbicides, - genotypes differ in herbicide response for other reasons than root depth
  - ^{15}N or isotopic labelled water measure directly what we want to know!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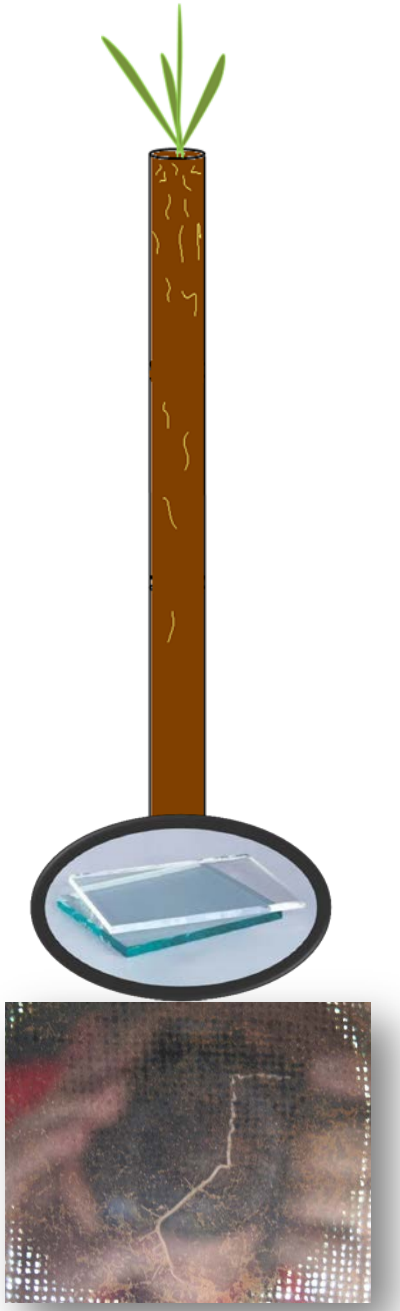

FAUPE results:

Better genotype separation with tracers than with direct root observation

Root observations significance in c. 35%

Tracers for root activity sign. in c. 75%

		Root parameters			Aboveground parameters		
Exp.	Treatment	Root depth	Deep root intensity	Deep root appearance	Herbicide symptom scale	Symptomatic leaf/stem numbers	^{15}N enrichment
1S	Herbicide	**Ap>Da**	**Ap>Da**	**Ap>Da**	**Ap>Da (*)**	**n/a**	
2W	Herbicide	=	**Ta>Ge (*)**	**Ta>Ge**	**Ta>Ge (***)**	**Ta>Ge (***)**	
	^{15}N	=	**Ta>Ge (*)**	**Ta>Ge (*)**			**Ta>Ge(*) [3]**
3S	Herbicide	=	**Da>Ap [2]**	**Da>Ap**	=	**Da>Ap [1]**	
	^{15}N	**Ap>Da (*)[1]**	**Ap>Da**	**Ap>Da (*)[2]**			**Ap>Da (**)[3]**
4W	Herbicide	**Ta>Ge**	=	**Ta>Ge**	**Ta>Ge (***)**	**Ta>Ge (*)**	
	^{15}N	**Ta>Ge**	=	=			**Ta>Ge**
5W	Cone	**Ta>Ge (*) [2]**	**Ta>Ge (**)**	**Ta>Ge[3]**			
	^{15}N	**Ta>Ge (**) [2]**	**Ta>Ge**	**Ta>Ge[3]**			**Ta>Ge(*) [3]**

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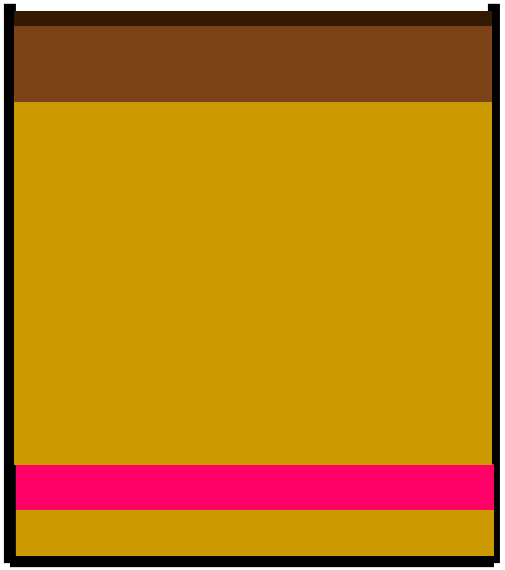
Simple screening: Deep placement of herbicides



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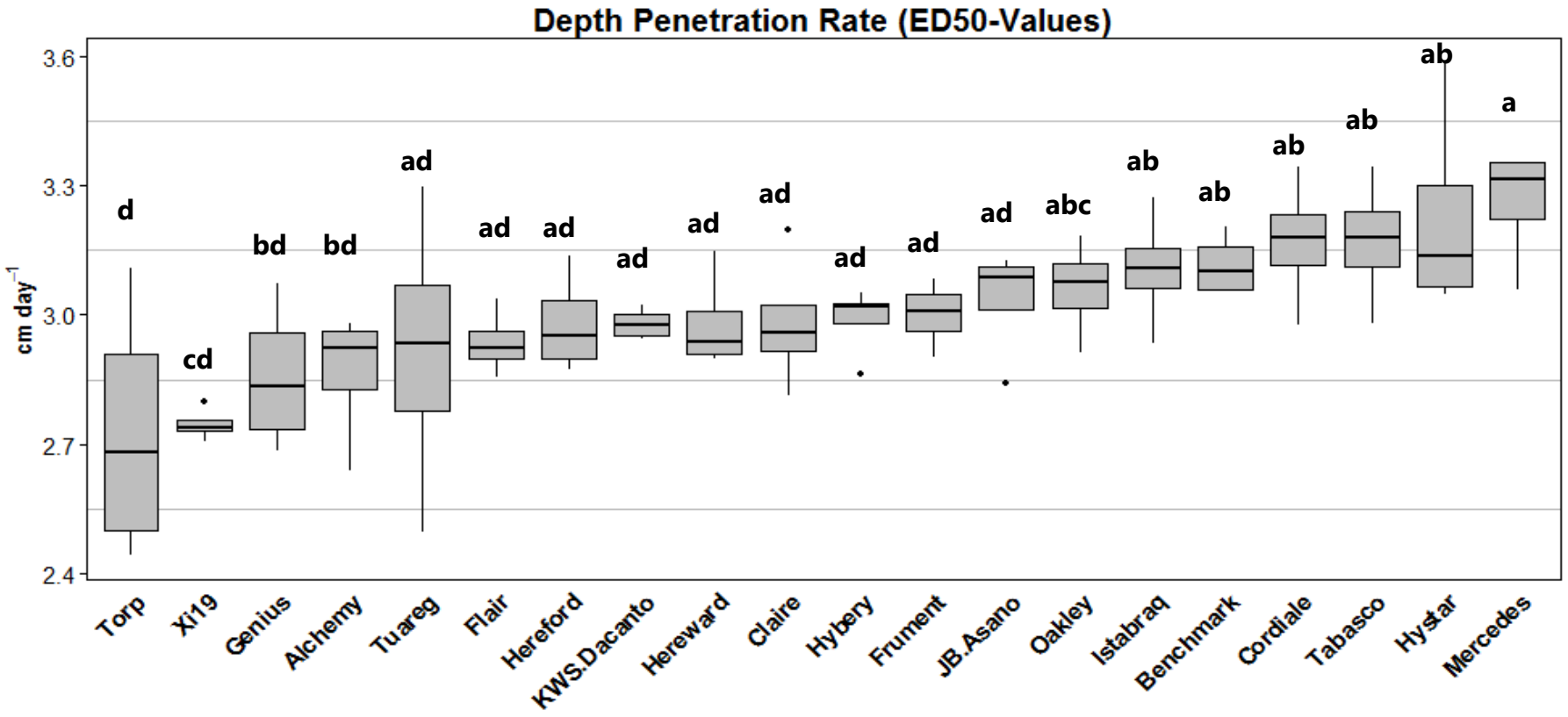

"Herbicide box" plans for 2018

- Soil herbicide can be applied when box is filled up, water and N are too mobile for this
  - Develop method that allow tracer application during plant growth
  - 2-10 days before measurement
  - First attempt as in RadiMax

  - Compare ^{15}N and water tracers and their efficiency

Field validation of RadiMax

- Experiments at five locations
  - Sandy soils at Ytteborg and Esbjerg
  - Sandy loam soils near Odense, Ringsted and at KU Taastrup

- Field validation of RadiMax?
- Barley 2017: Some overlap of genotypes,
  - Grown in RadiMax in 2017 or 2016

- Wheat 2018: All Robusta genotypes also in the KU lines in RadiMax

Barley field experiment 2017

1. Tocada
2. Laurikka
3. Evergreen
4. RGT Planet
5. Invictus
6. Flair
7. Simba

- 5 locations on different soil types
  - Esbjerg, Ytteborg, Odense, Ringsted og KU-Taastrup
  - At KU-Taastrup we had 2 N levels
    - norm and norm-40 kg N/ha

Preliminary yield and N data
Average of locations

	DM (hkg/ha)	N yield (kg N/ha)	%N in grain
Tocada	45.1	83.8	1.87
Laurikka	49.4	90.5	1.85
Evergreen	49.7	89.5	1.81
RGT Planet	51.4	91.3	1.79
Invictus	49.2	89.0	1.82
Flair	48.7	89.7	1.86
Simba	46.5	91.3	1.98

Field validation – nitrogen use efficiency

- N Uptake, NUE and NHI
  - They are combined results of root and shoot traits
- Shoot demand
  - Early vegetative demand - when most of the uptake occur
  - Grain development demand, - mostly re-allocation
- Early – biomass, tillering, LAI, and C/N balance
- Grain – yield and C/N balance (% protein)
- Moderate C/N differences in barley grain
  - But there were clear differences in 2017
  - Larger in wheat in 2018, bread wheat v.s. feed wheat

Field validation – crop N dynamics

- 5 locations – 2N levels here at KU
  - Usual harvest and analysis

  - **Full biomass samplings**
  - Sampling at flowering – biomass and N uptake
  - Sampling at GS 85-87, fully mature but before losses
  - Straw and grain to be analyzed

Field validation – sampling tissue for physiological phenotyping

- Tissue sampling for physiological phenotyping
  - Flag leaves at flowering
  - Flag leaves at mid grain filling (as source tissue for C and N)
  - Grains at mid grain filling (sink tissue)

Wheat genotypes sown for 2018 experiment

- Sherif — Low vegetative growth
- Benchmark — Strong vegetative growth
- Ohio — Above general yield/N regression
- Torp — Below general yield/N regression
- KWS Montana — High grain protein
- Claire — Low rooting depth 2016
- KWS Dacanto — Deep rooting 2016