Roots to the Future

Full Programme

8th Symposium of the International Society of Root Research

26-29 June 2012

Dalhousie Building, University of Dundee
Roots to the Future
8th Symposium of the International Society of Root Research

Gold Sponsors

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Annals of Botany
CID BioScience
Journal of Experimental Botany
The James Hutton Institute

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Dr Glyn Bengough (The James Hutton Institute and University of Dundee)
Professor Philip White (The James Hutton Institute)
Dr Blair McKenzie (The James Hutton Institute)
Dr Tim George (The James Hutton Institute)
Dr Paul Hallett (The James Hutton Institute)
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Dr Michelle Watt, Australia
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Assistant Professor Seth Pritchard, USA
Professor Heljä-Sisko Helmisaari, Finland
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Welcome to the ISRR Meeting in Dundee

Dear Colleagues

It is a great pleasure to welcome you all to the 8th Symposium of the International Society of Root Research. We have fellow root researchers from over 35 countries attending the meeting, so many of you will have travelled considerable distances to be present.

In arranging the programme the organising committee has tried to accommodate the huge spectrum of interests shared by members of our community ranging from molecular to crops and Arabidopsis to mature trees. We hope that you will find the science stimulating and benefit from the “corridor” discussions that often lead to new lines of enquiry and new collaborations. We have also included in the programme important elements of life in Dundee such as the old plant-based industries of flax and jute, the famous Antarctic exploration in the ship Discovery, and contemporary cultural aspects of Scottish life including golf, whisky and ceilidhs.

Research on roots and root systems is thriving at the James Hutton Institute (formerly the Scottish Crop Research Institute, SCRI) in Dundee and I am most grateful to the staff there for their support and hard work in organising this conference. I’m sure that we are to have a fantastic week.

I look forward to seeing you at the various lectures and events.

Peter Gregory
President of ISRR
We were encouraged greatly by the huge interest and kind support received for the “Roots to the Future” Conference, the 8th Symposium of the International Society of Root Research. The excellent scientific contributions received shows that root research is both vibrant and increasingly addressing the global environmental challenges of food and resource security.

There are many people to be thanked for making this event a success: Peter Gregory for initiating the conference and offering continued support and wise counsel, and our impressive list of sponsors for their generous support. An active local organising committee did all of the groundwork, ranging from finding a venue to organising social events such as the Civic Reception at Discovery, a Whisky Tasting, and the trips around the local area planned this week. Karen Tocher and Debbie Burton from the Dundee and Angus Convention Bureau, Anne Rendall from the James Hutton Institute, and Anne Walker from Congrex offered highly professional support and advice to keep the scientists on the right track!

The International Programme Committee, Keynote Speakers, and Session Chairs are thanked for initially shaping and subsequently helping to deliver the scientific programme. We were delighted and impressed by the quality of the submissions received and by the widest-yet global representation of any ISRR meeting. This promises to be a fascinating week, which we very much hope you will enjoy.

Glyn Bengough
Chair, International Programme Committee, & co-Chair, Organising Committee
Practical information

WiFi and use of University computers
Please complete the registration form for your User-i.d. if you require computer access or WiFi access during the conference. We have access to an IT-suite of computers on the ground floor (IT suite 3)

Lecture theatres, poster rooms, and “Talking Posters”
All talks are in the lecture theatres 2, 3, and 4: Lecture theatre 3, one floor above the foyer, is the largest where the Plenary Lectures will be held. Posters are either in room 1.F.06 or 1.F.01, situated one floor above the main foyer. “Talking Posters” are simply posters that will be displayed throughout the conference, and that additionally have a short associated talk (on Wednesday or Thursday in Lecture theatre 2).

Talk upload & poster mount
Please upload and check your talk as early as possible in the IT-suite — ideally at registration on the Monday evening, when most helpers are available. Please mount your poster for Poster Session 1 either on the Monday evening or Tuesday morning before 10:30, and remove it before 13:00 on Wednesday. Posters for poster session 2 should be mounted during Wednesday lunchtime, after 13:00. “Talking Poster” posters should remain on display throughout the meeting.

Lunch marquee, tea/coffee breaks, Sponsor stalls
Tea and coffee breaks will be served on both upper and lower foyers of the Dalhousie building. For speed, we have arranged “take away” deli-bags of food for lunch, served in the marquee on the University Campus Green, 2 minutes walk south of the Dalhousie building. There are tables and chairs to eat your lunch there, or else bring it back to Dalhousie to look at the posters, and visit the stalls of our sponsors.

Dundee city map & book of discount vouchers – all inside your “Dundee Passport” folder
In your delegate bag, you will find a small folder (your “Dundee Passport”). This includes a map of the city centre, to help you find your way to and from the hotel. This is full of special offers available only for conference delegates. We encourage you to use it, as it includes discounts at visitor attractions and restaurants (please take the vouchers with you when you visit).

Conference Reception Desk and Conference Help Volunteers
The Conference Reception Desk is located in the Dalhousie Building foyer, and will be manned during the conference sessions. Please ask any of our Conference Helpers (identified by their “iSRR-Team” T-shirt) for assistance in finding a venue, loading talks, mounting posters or for recommendations on activities in the local area. The Reception Desk can also assist with information on bus transfers to conference events, airport transport and tourist activities.
Dundee City and Campus map
Programme Overview

The Author Index, at the back, refers to the abstract code of each presentation.

Plenary Keynote Lectures (abstract code PLK) are in Lecture Theatre 3.

Plenary Session lectures (code PL) are in Lecture Theatre 3 on Tuesday and Friday mornings, to open and close the conference.

Split Sessions: (code SS) The programme is split into 3 parallel strands – these deal with Root Function (Function 1, 2, 3, 4, all in Lecture Theatre 3), Root Interactions (Interactions 1, 2, 3, 4, 5 initially in Lecture Theatre 4), and Environment (Environment 1, 2, 3 initially in Lecture Theatre 2). Each of these split sessions will normally start with a Split Session Keynote (code SKN).

There is an additional session on Emerging Methods (code EM), and several sessions of brief presentations for “Talking Posters” (code TP) – aimed to raise the profile of the poster sessions.

Posters (code P) are ordered by subject area strand (Function, Environment, Interactions).

<table>
<thead>
<tr>
<th>Poster numbers</th>
<th>Day</th>
<th>Room</th>
<th>Poster subject group</th>
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</thead>
<tbody>
<tr>
<td><strong>Poster Session 1</strong></td>
<td></td>
<td></td>
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<tr>
<td>TP01-26</td>
<td>Tuesday-Friday</td>
<td>1.F06</td>
<td>“Talking Posters” on display</td>
</tr>
<tr>
<td>P001-P062</td>
<td>Tuesday afternoon</td>
<td>1.F06</td>
<td>Function 1</td>
</tr>
<tr>
<td>P067-P080</td>
<td>Tuesday afternoon</td>
<td>1.F06</td>
<td>Function 2 (split between rooms)</td>
</tr>
<tr>
<td>P084-P106</td>
<td>Tuesday afternoon</td>
<td>1.F01</td>
<td>Function 2 (split between rooms)</td>
</tr>
<tr>
<td>P109-P111</td>
<td>Tuesday afternoon</td>
<td>1.F01</td>
<td>Interactions 1</td>
</tr>
<tr>
<td>P113-P120</td>
<td>Tuesday afternoon</td>
<td>1.F01</td>
<td>Environment 1</td>
</tr>
<tr>
<td>P122-P132</td>
<td>Tuesday afternoon</td>
<td>1.F01</td>
<td>Environment 2</td>
</tr>
</tbody>
</table>

| **Poster Session 2** |                 |      |                                        |
| TP01-26          | Tuesday-Friday  | 1.F06| “Talking Posters” on display           |
| P203-P241        | Thursday afternoon| 1.F06| Function 3                             |
| P244-P272        | Thursday afternoon| 1.F06| Interactions 3                         |
| P273-P282        | Thursday afternoon| 1.F06| Interactions 4                         |
| P285-P290        | Thursday afternoon| 1.F01| Interactions 5                         |
| P293-P308        | Thursday afternoon| 1.F01| Environment 3                         |
| P309-            | Thursday afternoon| 1.F01| Function 4 and Others                 |
### Monday 25 June

| 17:00-20:00 | Registration, the Dalhousie Building  |
|            | Welcome Reception with light refreshments  |
|            | Opportunity to load/test powerpoint presentations and mount posters  |

### Tuesday 26 June

| 08:00-09:00 | Last Minute Registration  |
|            | Poster Mounting, Main Area  |

| 09:20 | Conference Welcome  |
| 09:30 | Plenary Keynote, J. Lynch  
*Roots of the second green revolution: exploiting the root pheneome*  |
| 10:30 | Coffee  |
| 11:00 | Plenary Session  |
| 12:40 | Lunch  |
| 13:45-15:00 | Posters (TP01 to TP26; P001 to P083 Room 1.F.06; Posters P084-P132 in Room 1.F.01), CID Biosciences, Lecture Theatre 3  |
| 15:00 | Plenary Keynote, M. Bennett  
*Root gravitropism: providing a sense of direction*  |

**Split Session**

| 15:45 | Function 1: Genes, traits and the environment  
Interactions 1: Root-soil structure interactions  
Environment 1: Environmental impact and carbon cycling  |
| 17:35 | Depart for Civic Reception, RRS Discovery (starts at 18:00)  |

### Wednesday 27 June

| 09:00 | Plenary Keynote, B. Sharp  
*Root growth under water deficits: physiological complexity and coordination*  |
| 09:45 | Function 2: Root function and uptake  
Interactions 2: Exudates  
Environment 2: Hostile Conditions  |
| 10:30 | Coffee  |
| 11:00 | Function 2: Root function and uptake  
Interactions 2: Exudates  
Environment 2: Hostile Conditions  |
| 12:40 | Lunch  |
| 14:00 | Plenary Keynote, P. Hinsinger  
*The roots of our soils*  |
| 14:45 | Function 3: Evolution and function of root structures  
Interactions 3: Root-microbe interaction  
Talking posters  |
| 15:30 | Coffee  |
| 16:00 | Function 3: Evolution and function of root structures  
Interactions 3: Root-microbe interaction  
Talking posters  |
| 17:30 | Leave for visit to Verdant Works (optional)  |
| 18:45 | ISRR Business Meeting, Verdant Works (Buffet Served)  |
### Thursday 28 June

<table>
<thead>
<tr>
<th>Time</th>
<th>Lecture Theatre 3</th>
<th>Lecture Theatre 4</th>
<th>Lecture Theatre 2</th>
</tr>
</thead>
</table>
| 09:00  | Plenary Keynote, M. Watt<br>
*Speeding up the delivery of root system improvements to farmers to increase crop productivity* |                                   |                  |
| 09:45  | Function 4: Roots in the field                                                   | Interactions 4: Water             | Talking Posters  |
| 10:30  | Coffee                                                                           |                                   |                  |
| 11:00  | Function 4: Roots in the field                                                   | Interactions 4: Water             | Talking Posters  |
| 12:40  | Lunch                                                                            |                                   |                  |
| 13:45-15:00 | Posters (P201-P283 and TP01 to TP26 in Room 1.F.06; P284-P323 in Room 1.F.01) |                                   |                  |
| 14:00-14:20 | Lemnatec                                                          |                                   |                  |
| 15:00  | Plenary Keynote, J. Abe<br>
*Morphology and anatomy of rice roots* |                                   |                  |
| 15:45  | Environment 3: Roots and changing environments<br>
*Interactions 5: Root sensing of the environment* | Emerging methods                 |                  |
| 17:35  | End of session                                                                  |                                   |                  |
| 18:45  | Leave for Conference Dinner - Fairmont Hotel, St. Andrews<br>
*(please be aware of your bus pickup point)* |                                   |                  |
| 24:00  | Return to Dundee                                                                 |                                   |                  |

### Friday 29 June

<table>
<thead>
<tr>
<th>Time</th>
<th>Lecture Theatre 3</th>
<th>Lecture Theatre 4</th>
<th>Lecture Theatre 2</th>
</tr>
</thead>
</table>
| 09:10  | Plenary Keynote, H-S Helmisaari<br>
*Fine roots and soil carbon in boreal forests* |                                   |                  |
| 09:50  | Plenary Keynote, F. Zhang<br>
*Maximizing root/rhizosphere efficiency for improving crop productivity and nutrient use efficiency* |                                   |                  |
| 10:30  | Coffee                                                                           |                                   |                  |
| 11:00  | Plenary Session                                                                  |                                   |                  |
| 12:20  | Plenary Keynote and Conference Synopsis, P. Gregory, ISRR President<br>
*Roots to the future and routes to sustainability* |                                   |                  |
| 13:00  | Lunch (please remove any remaining posters)                                      |                                   |                  |
| 14:00  | Optional visits to the James Hutton Institute or the Old Course, St. Andrews (Course Superintendent Tour), or Botanic Gardens |                                   |                  |

### Session Sponsors

We are very grateful to the following Sponsors, who are associated with the following sessions.

CID Bioscience – Sponsors of the “Roots in the Field” session

British Society of Soil Science – Sponsors of the “Root-soil structure interactions” session

New Phytologist Trust – Sponsors of the “Root function and uptake” session

Centre for Plant Integrative Biology, University of Nottingham – Sponsors of Plenary Keynote by Professor Fusuo Zhang

Euroot – Sponsors of the “Roots for sustainable production” session

Regent Instruments – Sponsors of the Poster Session Prizes
Social Programme – a warm Scottish Welcome!

We like to boast that there is nowhere as welcoming as Scotland – and not just because of the whisky – though it does help!

We want you to enjoy the conference as much as possible and have lined up several social events where you can network over a glass – or two! – and enjoy our hospitality.

Civic Reception – Discovery Point Visitor Centre
Tuesday June 26 2012 Discovery Point 18:00-20:00 (leave on foot with guides by 17:40)
Dundee is home to the historic ship RRS Discovery, which was built here for the 1901 British National Antarctic Expedition - the vision of Sir Clements Markham, President of the Royal Geographical Society. After being rescued from imprisonment in the ice, the ship went on to make two more journeys to the Southern Seas. The ship then came back to be the namesake and centrepiece of a major tourism campaign for Dundee in 1986. The Lord Provost of Dundee, Bob Duncan, will welcome delegates to the city and the James Hutton Institute’s Chief Executive, Professor Iain Gordon, will also give a short welcome. Thereafter, a buffet reception, whisky tasting and optional tour of the ship and visitor centre will follow. We will walk from the Dalhousie Building to the ship, which should take around 15 minutes.

Tour of Verdant Works – Scotland’s Jute Museum
Wednesday June 27 2012 18:00-20:00 (leave on foot with guides by 17:40)
A wine reception and tour of this fascinating piece of Dundee’s industrial history, will take place immediately after the conference on Wednesday. The museum is only five minutes walk from the conference venue. Verdant Works is the sister visitor experience to Discovery Point, telling the tale of Dundee’s years as the centre of the world jute industry, so much so that it was given the nickname Juteopolis. For those not familiar with it, this coarse fibre, gown mainly in India was indispensable during the 19th and early 20th centuries for sacking, ropes, boot linings, aprons, carpets, tents, roofing felts, and much much more.

Conference dinner, Fairmont Hotel, St Andrews
Thursday June 28 2012 (leave by coach at 18:45 sharp, check your pickup point at registration: coaches can not wait)
St Andrews, home of golf, is our venue for the conference dinner. This contemporary hotel is just a couple of miles outside the medieval town. We look forward to an evening of dining followed by a Scottish ceilidh: dress code is smart casual.
Optional Friday Afternoon Tours

Friday June 29 2012

Scottish weather is very unpredictable — please bring a jumper, raincoat or umbrella, and strong shoes (in case of rain and wet paths).

The James Hutton Institute
(leave by coach at 14:00 from Dalhousie)

The James Hutton Institute brought together over 600 scientists from the Macaulay Land Use Research Institute and SCRI on 1 April 2011. The new organisation combines existing strengths in soils, crops, land use and environmental research, and will make major, new contributions to the understanding of key global issues, such as food, energy and environmental security, and developing and promoting effective technological and management solutions to these.

Root research is a key topic for the institute. This tour will show a selection of laboratory/glasshouse facilities and field experiments.

The Old Course, St. Andrews – Sponsored by Aquatrols
(leave by coach at 14:00 from Dalhousie)

Gordon Moir, Director of Greenkeeping at St. Andrews, and his team will demonstrate the skilled agronomy behind maintaining the oldest and most famous golf course in the world. The Links Soil beneath St. Andrews is mimicked globally to produce an ‘ideal’ root zone for golf. Considerable effort and science lies beneath the maintenance of a premier golf course. The practices and technologies used to improve soil conditions for grass and golf play will be presented. Also on display will be instruments to monitor root zone properties and equipment to ameliorate problems.

University of Dundee Botanic Garden
(2 km walk from Dalhousie, no transport provided: leave on foot from Dalhousie at 14:00, to arrive at the garden in time for 14:45)

Alasdair Hood, the Garden Curator, has kindly agreed to show up to 25 delegates around the garden at 14:45 (note — this must be pre-booked directly with the garden by emailing j.e.forbes@dundee.ac.uk by the evening of Thursday 28th June). Delegates wishing to look around the garden themselves, unaccompanied, may obtain free entry by handing in their delegate badge at the Botanic Garden Visitor Desk.
**Tuesday 26 June**

**Lecture Theatre 3**

<table>
<thead>
<tr>
<th>Time</th>
<th>Ref</th>
<th>Talk / Event</th>
<th>Presenter</th>
</tr>
</thead>
<tbody>
<tr>
<td>08:00-09:00</td>
<td></td>
<td>Last-minute Registration</td>
<td></td>
</tr>
<tr>
<td>09:20</td>
<td></td>
<td>Welcome</td>
<td>Peter Gregory and Shigenori Morita</td>
</tr>
<tr>
<td>09:30</td>
<td>PL2</td>
<td>Plenary Keynote: Roots of the Second Green Revolution: Exploring the Root Phenome</td>
<td>Lynch</td>
</tr>
<tr>
<td>10:30</td>
<td></td>
<td>tea/coffee (10 mins)</td>
<td></td>
</tr>
<tr>
<td>11:00</td>
<td>PL1.1</td>
<td>Roots of the Second Green Revolution Chaired by Gregory &amp; Morita</td>
<td></td>
</tr>
<tr>
<td>11:20</td>
<td>PL1.2</td>
<td>The genetic architecture of the maize root system</td>
<td>Hund</td>
</tr>
<tr>
<td>11:40</td>
<td>PL1.3</td>
<td>The deeper rooting gene Drlk enhances drought avoidance in rice</td>
<td>Uga</td>
</tr>
<tr>
<td>12:00</td>
<td>PL1.4</td>
<td>Suborganelles activate different hormonal pathways for root development regulation in response to phosphate conditions</td>
<td>Kdai</td>
</tr>
<tr>
<td>12:20</td>
<td>PL1.5</td>
<td>Aeroponics as a tool for high throughput root phenotyping</td>
<td>Ligeza</td>
</tr>
<tr>
<td>12:40</td>
<td></td>
<td>Lunch</td>
<td></td>
</tr>
<tr>
<td>13:45</td>
<td></td>
<td>Poster Session 1 &amp; tea/coffee (first set of posters, swap over on Wednesday lunchtime)</td>
<td></td>
</tr>
<tr>
<td>14:00</td>
<td></td>
<td>CD Sponsors talk in Lecture Theatre 3 at 2pm - Tools and techniques for imaging and analysis of the roots in soil</td>
<td></td>
</tr>
<tr>
<td>15:00</td>
<td>PL2</td>
<td>Plenary Keynote: Root gravitropism: providing a sense of direction</td>
<td>Berrett</td>
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</table>

**Split Session**

<table>
<thead>
<tr>
<th>Time</th>
<th>Ref</th>
<th>Talk / Event</th>
<th>Presenter</th>
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</thead>
<tbody>
<tr>
<td>15:40</td>
<td></td>
<td>Function 1. Genes, traits and environment</td>
<td></td>
</tr>
<tr>
<td>15:45</td>
<td>SKN1.1</td>
<td>Exploring the intertwined genetic bases of root and shoot growth response to soil water deficit in Arabidopsis</td>
<td>Muller</td>
</tr>
<tr>
<td>16:15</td>
<td>SL1.1</td>
<td>Relationships between root development, P acquisition, crop establishment and yield of potato (Solanum tuberosum L.)</td>
<td>White</td>
</tr>
<tr>
<td>16:35</td>
<td>SL1.2</td>
<td>An ATP-binding cassette (ABC) transporter is required for formation of suberin lamellae at the hypodermis in rice</td>
<td>Shino</td>
</tr>
<tr>
<td>16:55</td>
<td>SL1.3</td>
<td>High throughput imaging and analysis of Irisbusca rapa root system architecture in response to P</td>
<td>Adu</td>
</tr>
<tr>
<td>17:15</td>
<td>SL1.4</td>
<td>“Methodological approaches to evaluate chemicals enabling root growth in crops”</td>
<td>Scerpantti</td>
</tr>
<tr>
<td>17:35</td>
<td></td>
<td>END</td>
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**Lecture Theatre 4**

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<th>Time</th>
<th>Ref</th>
<th>Talk / Event</th>
<th>Presenter</th>
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</thead>
<tbody>
<tr>
<td>15:40</td>
<td></td>
<td>Interactions 1. Root-soil structure interactions Chaired by Killeard &amp; Whalley</td>
<td></td>
</tr>
<tr>
<td>15:45</td>
<td>SKN1.2</td>
<td>How does variation in root traits affect barley cultivar responses to agriculturally relevant soil physical constraints?</td>
<td>Valentine</td>
</tr>
<tr>
<td>16:15</td>
<td>SL1.2</td>
<td>Can soil hydraulic properties be managed by cover crop roots?</td>
<td>Bodner</td>
</tr>
<tr>
<td>16:35</td>
<td>SL1.2</td>
<td>Rhizosphere plasticity — dynamic alteration of rhizosphere biophysical and chemical properties and the role of mucilage</td>
<td>Vetterlein</td>
</tr>
<tr>
<td>16:55</td>
<td>SL1.2</td>
<td>Role of root development in conferring soil strength</td>
<td>Dumbio</td>
</tr>
<tr>
<td>17:15</td>
<td>SL1.2</td>
<td>New transparent soil sheds light on 3D biological structures in the rhizosphere</td>
<td>Downie</td>
</tr>
<tr>
<td>17:35</td>
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<td>END</td>
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**Lecture Theatre 2**

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<th>Talk / Event</th>
<th>Presenter</th>
</tr>
</thead>
<tbody>
<tr>
<td>15:40</td>
<td></td>
<td>Environment 1. Environmental impact and carbon cycling Chaired by Kell &amp; Acuna</td>
<td></td>
</tr>
<tr>
<td>15:45</td>
<td>SKN1.3</td>
<td>Age-related changes in carbon allocation to root growth and respiration in a temperate beech forest</td>
<td>Epron</td>
</tr>
<tr>
<td>16:15</td>
<td>SL1.3</td>
<td>Influence of plant roots on the physical behaviour of soils</td>
<td>Halliet</td>
</tr>
<tr>
<td>16:35</td>
<td>SL1.3</td>
<td>Contribution of root and rhizomicrobial remains to subsoil organic matter — assessed in a loess-paneleu sequence</td>
<td>Gocke</td>
</tr>
<tr>
<td>16:55</td>
<td>SL1.3</td>
<td>Do differences in root distribution of rhizomastus and non-rhizomastus Miscanthus genotypes affect carbon sequestration?</td>
<td>Richer</td>
</tr>
<tr>
<td>17:15</td>
<td>SL1.3</td>
<td>Breeding plants with deep roots for carbon, water and nutrient sequestration: what may be achievable?</td>
<td>Kell</td>
</tr>
<tr>
<td>17:35</td>
<td></td>
<td>END</td>
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**Evening**

<table>
<thead>
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<td>19:30</td>
<td>Evening free</td>
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</table>
Plenary Keynote
Tuesday, June 26, 2012
09:20 - 10:30
Lecture Theatre 3
Chair: P Gregory, UK
Co-chair: S Morita, Japan

09:30
Roots of the Second Green Revolution: Exploiting the Root Phenome
Lynch, J.P.
The Pennsylvania State University, United States
Genotypic variation for root traits related to soil resource acquisition is being harnessed in crop breeding programs, with benefits for both poor and rich nations.

10:30 Coffee

Roots of the Second Green Revolution
Tuesday, June 26, 2012
11:00 - 12:40
Lecture Theatre 3
Chair: P Gregory, UK
Co-chair: S Morita, Japan

11:00
Root systems and crop improvement in rice
Price, A.H.
Institute of Biological and Environmental Sciences, University of Aberdeen, Cruickshank Building, Aberdeen, AB24 3UU, United Kingdom
Examples in rice will be given of: Conventional and marker assisted breeding to improve the root systems, Meta-analysis of root QTLs, Identification of genes underlying root growth or root function QTLs, The promise of association mapping, Low cost, high throughput root phenotyping approaches.

11:20
The genetic architecture of the maize root system
Hund, A.1 Reimer, R.2; Messmer, R.2; Walter, A.2
1Department of Environmental Systems Science, Institute of Agricultural Sciences, Universitätstrasse 2, Zurich, 8092, Switzerland; 2ETH Zurich, Switzerland
We present a consensus map of quantitative trait loci (QTLs) controlling root length of maize. The map includes QTLs detected in 9 mapping populations and can be considered the current “world map” concerning this trait. A total of 161 QTLs was grouped into 24 meta-QTLs and 16 individual QTLs.

11:40
The deeper rooting gene Dro1 enhances drought avoidance in rice
Uga, Y.1; Sugimoto, K.1; Ogawa, S.2; Rane, J.2; Ishitani, M.1; Kitomi, Y.3; Inukai, Y.3; Ono, K.1; Kanno, N.1; Hara, N.1; Wu, J.1; Matsumoto, T.1; Okuno, K.1; Yano, M.1
1National Institute of Agrobiological Sciences, 2-1-2, Kannondai, Tsukuba, Japan; 2International Center for Tropical Agriculture, Colombia; 3Nagoya University, Japan; 4University of Tsukuba, Japan
A deeper rooting QTL Dro1 was cloned in rice. Dro1 was involved in root gravitropism. The yielding capacity of a near-isogenic line for Dro1 was significantly higher than that of original variety in upland field with drought stress, demonstrating that Dro1 contributes to drought avoidance.
12:00
Strigolactones activate different hormonal pathways for root development regulation in response to phosphate conditions
Koltai, H.; Kapulnik, Y.; Resnick, N.; Mayzlish-Gati, E.; Kaplan, Y.; Wininger, S.
1Ornamental Horticulture, ARO, Volcani Center, POB 6, Bet Dagan, 50250, Israel; 2Agronomy and Natural Resources, ARO, Volcani Center, POB 6, Bet Dagan, 50250, Israel

Strigolactones (SLs) are a new group of plant hormones. Using physiological and genomic approaches, Koltai et al. demonstrated that SLs, ethylene and auxin converge for regulation of root development under different phosphate growth conditions, suggesting new components of the SLs response pathway.

12:20
Aeroponics as a tool for high throughput root phenotyping
Ligeza, A.; Draye, X.
Earth and Life Institute, Agronomy ELI-A, Université catholique de Louvain, Place Croix du Sud 2 - L705.11, Louvain-la-Neuve, 1348, Belgium

Methods of root phenotyping are characterized by low throughput or fail to address the dynamics of root growth. We present phenotyping platform based on aeroponics. Image analysis allows to capture dynamic features of RSA. The validity of aeroponics data as indicators of field variables is discussed.

12:40 Lunch followed by Poster Session 1

Plenary Keynote
Tuesday, June 26, 2012
15:00 - 15:40
Lecture Theatre 3
Chair: M Humphreys, UK
Co-chair: R Sharp, US

15:00
Root gravitropism: providing a sense of direction
Bennett, M.
School of Biosciences, University of Nottingham, Sutton Bonington, Loughborough, LE12 5RD, United Kingdom

Roots employ directional signals like gravity to explore the soil environment and acquire anchorage and resources. I will describe the molecular and cellular mechanisms underpinning gravitropism and describe how novel tools and systems approaches are revealing new insights.

Function 1: Genes, traits & environments
Tuesday, June 26, 2012
15:45 - 17:35
Lecture Theatre 3
Chair: M Humphreys, UK
Co-chair: R Sharp, US

15:45
Exploring the intertwined genetic bases of root and shoot growth response to soil water deficit in Arabidopsis
Muller, B.; Bouteillé, M.
LEPSE, INRA, 2 place Viala, Montpellier, 34060, France

Using the model plant Arabidopsis and various genetic resources, we show (i) that the regions of the genome that control root and shoot growth show large overlap and (ii) that water deficits tend to weaken these links suggesting root growth shifts from source to sink limitation under drought.
17:15
**Relationships between root development, P acquisition, crop establishment and yield of potato (Solanum tuberosum L.)**

White, P.J.; Brown, L.K.; George, T.S.; Ramsay, G.2; Subramanian, N.K.; Thompson, I.A.; Wishart, J.; Wright, G.M.1

1Ecological Sciences, The James Hutton Institute, Invergowrie, Dundee, United Kingdom; 2Cell and Molecular Sciences, The James Hutton Institute, Invergowrie, Dundee, United Kingdom

Roots represent an important agronomical trait. Among the different strategies for improving this trait there are those based on the use of chemicals or microorganisms. In this context, an ad-hoc screening to evaluate chemicals with root promotion effects has been developed.

SS1.12

16:35
**An ATP-binding cassette (ABC) transporter is required for formation of suberin lamellae at the hypodermis in rice**


1Fukui Prefectural University, Japan; 2The University of Tokyo, Japan; 3Nagoya University, Japan; 4University of Bonn, Germany; 5Kobe Pharmaceutical University, Japan; 6Hokkaido University, Japan; 7Kyoto University, Japan; 8Obihiro University of Agriculture and Veterinary Medicine, Japan

Suberin is a constituent of apoplastic plant interfaces. So far there is no direct evidence that suberin forms an apoplastic barrier at the hypodermis in rice. Here, we show that a rice mutant that does not form suberin lamellae has a defective apoplastic barrier and poorly tolerates waterlogging.

SS1.11

16:55
**High throughput imaging and analysis of Brassica rapa root system architecture in response to [P]**

Adu, M.; White, P.J.; Dupuy, L.; Hammond, J.; Bennett, M.; Broadley, M.

1The James Hutton Institute, Invergowrie, DD2 5DA, United Kingdom; 2School of Biosciences, University of Nottingham, Sutton Bonington, LE12 5RD, United Kingdom

Root system architecture (RSA) determines plant phosphorus (P) acquisition and crop P-fertiliser use efficiency. We have built a high-throughput phenotyping platform to quantify the development of RSA with high spatial and temporal resolution. We will describe, and contrast, the RSAs of Brassica rapa genotypes in response to P availability.

SS1.13

17:15
**Methodological approaches to evaluate chemicals enabling root growth in crops**


1Syngenta Crop Protection, Schaffhauserstrasse, Stein, 4332, Switzerland; 2Syngenta Crop Protection, Jealott’s Hill, Bracknell, RG42 6EY, United Kingdom

Roots represent an important agronomical trait. Among the different strategies for improving this trait there are those based on the use of chemicals or microorganisms. In this context, an ad-hoc screening to evaluate chemicals with root promotion effects has been developed.

SS1.14
Interaction 1: Root-soil structure interactions  
Tuesday, June 26, 2012  
15:45 - 17:35  
Lecture Theatre 4  
Chair: J Kirkegaard, Australia  
Co-chair: R Whalley, UK

15:45
How does variation in root traits affect barley cultivar responses to agriculturally relevant soil physical constraints?
Valentine, T.1; Binnie, K.1; Squire, G.R.1; Hawes, C.1; Hallett, P.D.2; Bengough, A.G.1  
1Ecological Sciences, The James Hutton Institute, Evro Road, Invergowrie, Dundee, DD2 5DA, United Kingdom;  
2Environmental and Biochemical Sciences, The James Hutton Institute, Errol Road, Invergowrie, Dundee, DD2 5DA, United Kingdom  

Soil strength and pore space structure were major limitations to root elongation in arable soils. Potential differences in root traits linked to responses to soil physical constraints are assessed.
SS1.2

16:15
Can soil hydraulic properties be managed by cover crop roots?
Bodner, G.; Scholl, P.; Loiskandl, W.; Kaul, H-P.  
Department of Crop Sciences, University of Natural Resources and Life Sciences, Gregor Mendel Straße 33, Vienna, Austria  

Soil hydraulic properties in the structural range are subject to high spatio-temporal variability. Roots of cover crops showed effects in the large macropore range and contribute to pore stabilization. Environmental factors however are the main drivers of temporal dynamics.
SS1.21

16:35
Rhizosphere plasticity – dynamic alteration of rhizosphere biophysical and -chemical properties and the role of mucilage
Vetterlein, D.  
Soil Physics, Helmholtz Centre for Environmental Research - UFZ, Theodor-Lieser-Str. 4, Halle, 06120, Germany  
Rhizosphere plasticity mediated by the presence or absence of mucilage enables plants to dynamically adapt rhizosphere biophysical and biochemical properties in order to optimise the acquisition of water and nutrients on a whole plant scale.
SS1.22

16:55
Role of root development in conferring soil strength
Dumlao, M.R.1; Silk, W.K.; Goyal, V.; Ramananarivo, S.2; Dejong, J.T.3  
1Land, Air, and Water Resources, University of California, Davis, One Shields Avenue, Davis, 95616, United States;  
2École Normale Supérieure, France; 3Department of Civil and Environmental Engineering, University of California, Davis, One Shields Avenue, Davis, 95616, United States  

A developmental perspective was used to study the effects of root growth on soil stability. Soil strength increased during plant growth, which was associated with increased root abundance and increased root mechanical strength.
SS1.23

17:15
New transparent soil sheds light on 3D biological structures in the rhizosphere
Downie, H.1; Holden, N.2; Otten, W.3; Spiers, A.J.; Valentine, T.A.; Dupuy, L.X.1  
1Ecological Sciences, The James Hutton Institute, Invergowrie, Dundee, DD2 5DA, United Kingdom; 2The James Hutton Institute, Invergowrie, Dundee, DD2 5DA, United Kingdom; 3The SIMBIOS Centre, University of Abertay Dundee, Bell Street, Dundee, DD1 1HG, United Kingdom  

Transparent soil is a growth substrate that mimics the heterogeneity and chemical properties of soil and allows imaging of roots and microorganisms using established microscopy methods.
SS1.24
**Environment 1: Environmental impact and carbon cycling**

**Tuesday, June 26, 2012**

**15:45 - 17:35**

**Lecture Theatre 2**

Chair: D Kell, UK

Co-chair: T Acuna, Australia

**15:45**

*Age-related changes in carbon allocation to root growth and respiration in a temperate beech forest*

Epron, D.

Lorraine University - Nancy, Faculté des Sciences, Vandoeuvre les Nancy, 54506, France

Combining a mass-balance approach and ecosystem CO2 flux measurements, changes in carbon allocation to root growth and respiration with stand age were reported in a temperate beech forest, reflecting shifts in resource limitations.

SSN1.3

**16:15**

*Influence of plant roots on the physical behaviour of soils*

Hallett, P1; Barre, P2; Bengough, A.G.1,3; Loades, K.W.1; Duckett, N.R.1; Knappett, J A.3; Paterson, E.1; Daniell, T.1; Caul, S.1; Zhang, B.5

1The James Hutton Institute, Invergowrie, Dundee, DD2 5DA, United Kingdom; 2Geology Laboratory, CNRS-ENS, Ecole normale supérieure, 24 rue Lhomond, Paris, 75005, France; 3Division of Civil Engineering, University of Dundee, Dundee, DD1 4HN, United Kingdom; 4The James Hutton Institute, Craigiebuckler, Aberdeen, AB15 8QH, United Kingdom; 5Key Laboratory of Plant Nutrition and Nutrient Cycling of Ministry of Agriculture of China, Institute, CAAS, Beijing, 100081, China

How plant roots influence the physical properties of soil has been quantified using a range of approaches adopted from materials science. This includes how root exudates enhance interparticle bonding, dispersion and aggregation processes, in addition to roots acting as fibre reinforcing rods in soil.

SSN1.31

**16:35**

*Contribution of root and rhizomicrobial remains to subsoil organic matter – assessed in a loess-paleosol sequence*

Gocke, M.; Wiesenberg, G.L.B.

Department of Agroecosystem Research, University of Bayreuth, Universitätstr. 30, Bayreuth, 95440, Germany

Based on lipid molecular proxies, amounts of root and rhizomicrobial OM were assessed in the subsoil which contains highly abundant rhizoliths. An extension of several cm of the former rhizosphere indicates a significant contribution of deep-rooting plants to the subsoil organic carbon pool.

SSN1.32

**16:55**

*Do differences in root distribution of rhizomatous and non-rhizomatous Miscanthus genotypes affect carbon sequestration?*

Richter, G.; Agostini, F; Barker, A.

Sustainable Soils and Grassland Systems, Rothamsted Research, West Commons, Harpenden, AL5 2JQ, United Kingdom

Rooting density, soil organic carbon and δ13C profiles under Miscanthus showed genotypic differences in terms of absolute accumulation and distribution. C4-roots clearly caused a strong shift of δ13C in topsoils due to RLD distribution and yield of the genotypes with only small shifts in subsoils.

SSN1.33

**17:15**

*Breeding plants with deep roots for carbon, water and nutrient sequestration: what may be achievable?*

Kell, D.

BBSRC & School of Chemistry and MIB, The University of Manchester, United Kingdom

An extra 1m depth of roots deployed over existing croplands and grasslands (ca 2300 Mha each) can have a very substantial impact in mitigating CO2 increases (see also http://dpkgroup.org/carbonsequestration/rootsystem.html); we need to breed plants that can produce them.

SSN1.34
<table>
<thead>
<tr>
<th>Time</th>
<th>Ref</th>
<th>Talk / Event</th>
<th>Presenter</th>
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<tr>
<td>09:00</td>
<td>PLK3</td>
<td>Plenary Keynote: Chaired Brown &amp; Daye Root growth under water deficits: physiological complexity and coordination</td>
<td>Sharp</td>
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<td>09:40</td>
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<td>Split Session</td>
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<tr>
<td>09:45</td>
<td>SKN2.1</td>
<td>Genetically enhanced root suberin levels regulate shoot ion conformation and improved drought tolerance</td>
<td>Frankle</td>
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<td>10:15</td>
<td>SJ2.11</td>
<td>Auxinodopsis root nutrient acquisition responses to changing water and nutrient supply</td>
<td>Chapman</td>
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<tr>
<td>10:30</td>
<td>tea/coffee (30 min)</td>
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<tr>
<td>11:00</td>
<td>SJ2.12</td>
<td>Modeling zinc uptake via ZIP transporters</td>
<td>Gauthier</td>
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<td>11:20</td>
<td>SJ2.13</td>
<td>Phosphorus uptake by Brassica napus from nutrient solution is limited by diffusion and not by membrane transport</td>
<td>Sanner</td>
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<tr>
<td>11:40</td>
<td>SJ2.14</td>
<td>Where do roots take up water? A technique to quantify local root water uptake</td>
<td>Jezlaat-Pelucki</td>
</tr>
<tr>
<td>12:00</td>
<td>SJ2.15</td>
<td>Auxin is involved in the responses of root cluster formation and clone excision P. P limitation in white lupin</td>
<td>Shen</td>
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<td>12:20</td>
<td>SJ2.16</td>
<td>Model-based analysis of resource capture by lettuce roots exposed to temporally or spatially dynamic stress</td>
<td>Kebirizadeh</td>
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<td>12:40</td>
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<td>End of Split session</td>
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<td>14:00</td>
<td>PLK4</td>
<td>Plenary Keynote: Chaired Price &amp; Eshed The roots of our soils</td>
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<td>14:30</td>
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<td>Split Session</td>
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<td>14:40</td>
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<td>Function 3. Evolution and function of root structures Chaired by Price and Eshel</td>
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<td>14:45</td>
<td>SKN31</td>
<td>Anatomical aspects of angiosperm root evolution</td>
<td>Seago</td>
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<td>15:15</td>
<td>SJ3.11</td>
<td>Four Dimensional Phenotyping of Graftvampom in Rice Roots and Potential Impacts on Phosphate Acquisition</td>
<td>Zappala</td>
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<tr>
<td>15:30</td>
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<td>Coffee</td>
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<tr>
<td>16:00</td>
<td>SJ3.12</td>
<td>Aseine dual action paradox and its possible role in root system shaping</td>
<td>Dubrovsky</td>
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<tr>
<td>16:20</td>
<td>SJ3.13</td>
<td>The cell wall defense reactions to abiotic stress in the root apoplast/epiderm</td>
<td>Lux</td>
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<tr>
<td>16:40</td>
<td>SJ3.14</td>
<td>Molecular protein expression among shoot-borne roots and their laterals</td>
<td>Zobel</td>
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<tr>
<td>17:00</td>
<td>SJ3.15</td>
<td>Root morphological and architectural characteristics of T. repens x T. uniformis interspecific hybrids</td>
<td>Nichols</td>
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<td>17:30</td>
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<td>Leave for optional visit to Verandt works light refreshments, with BIR Business meeting at 18:45 - 19:30 (provide Buffet for those attending meeting Meeting room at Verandt Works for up to 80)</td>
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<td>19:30</td>
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<td>Evening Free</td>
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<td>09:40</td>
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<td>Split Session</td>
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<td>09:45</td>
<td>SKN2.2</td>
<td>Interactions 2. Exudates Chaired by Hirsinger &amp; Neumann</td>
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<tr>
<td>10:15</td>
<td>SJ2.21</td>
<td>Rhizohumus as a future breeding target for improved abiotic stress tolerance in cereals</td>
<td>George</td>
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<tr>
<td>10:30</td>
<td>tea/coffee (30 min)</td>
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<tr>
<td>11:00</td>
<td>SJ2.22</td>
<td>Aluminium tolerance of root hairs undulates genotypic differences in rhizosphere/size of wheat grown on acid soil</td>
<td>Delhaize</td>
</tr>
<tr>
<td>11:20</td>
<td>SJ2.23</td>
<td>Roots as source of fatty acids in soil traced in a triple 13CO3 pulse labeling experiment</td>
<td>Wiesenberger</td>
</tr>
<tr>
<td>11:40</td>
<td>SJ2.24</td>
<td>Detection of pH gradients in between acidifying and alkalinizing roots with a novel camera pH-sensor system</td>
<td>Schreiber</td>
</tr>
<tr>
<td>12:00</td>
<td>SJ2.25</td>
<td>Intercropping system output relies on rhizosphere modification differing in species and soil pH</td>
<td>Zhang</td>
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<tr>
<td>12:40</td>
<td>SJ2.26</td>
<td>Benzoxazinoids in root exudates of maize attract Pseudomonas putida to the rhizosphere</td>
<td>Neal</td>
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<tr>
<td>13:00</td>
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<td>Lunch</td>
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<td>14:00</td>
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<td>Split Session</td>
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<tr>
<td>14:30</td>
<td></td>
<td>Interactions 3. Root-microbe interaction Chaired by Baggis and Wissowa</td>
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<tr>
<td>14:45</td>
<td>SKN32</td>
<td>Phosphorus transporter gene in mycohizal Brachypodium distachyon</td>
<td>Granlund</td>
</tr>
<tr>
<td>15:15</td>
<td>SJ3.21</td>
<td>&quot;Influence of barley root exudates on community structure of ammonia oxidisers and nitrification rates in soil&quot;</td>
<td>Skiba</td>
</tr>
<tr>
<td>16:00</td>
<td>SJ3.22</td>
<td>Constraints on colonisation by arbuscular mycorrhizal fungi in pasture species in south-western Australasia</td>
<td>Orchard</td>
</tr>
<tr>
<td>16:20</td>
<td>SJ3.23</td>
<td>Role of auxin signaling in the interaction of Arabidopsis with the plant growth-promoting bacterium Azotobacter</td>
<td>Bossuyt</td>
</tr>
<tr>
<td>16:40</td>
<td>SJ3.24</td>
<td>Improving rice yield and quality through inoculation with mycorhiza and plant growth promoting rhizobacteria in India</td>
<td>Berest</td>
</tr>
<tr>
<td>17:00</td>
<td>SJ3.25</td>
<td>Nano LC-MS analysis on root secreting proteins</td>
<td>Shirano</td>
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Plenary Keynote
Wednesday, June 27, 2012
09:00 - 09:40
Lecture Theatre 3
Chair: K Brown, US
Co-chair: X Draye, Belgium

09:00
Root growth under water deficits: physiological complexity and coordination
Sharp, R.
Division of Plant Sciences, University of Missouri, 1-31 Agriculture Building, Columbia, 65211, United States
Root growth is critical for plant adaptation to drought. This presentation will focus on recent studies of the complexity and coordination of root growth regulation under water deficits, focusing on the role of apoplastic reactive oxygen species and modifications of cell wall extensibility.

Function 2:
Root function and uptake
Wednesday, June 27, 2012
09:45 - 10:30
Lecture Theatre 3
Chair: K Brown, US
Co-chair: X Draye, Belgium

09:45
Genetically enhanced root suberin levels regulate shoot ion accumulation and confer improved drought tolerance
Franke, R.
Institute of Cellular and Molecular Botany, University of Bonn, Kirschallee 1, BONN, 53113, Germany
The characterization of additional mutants with enhanced suberin content in roots provided genetic evidence that suberin is involved in the control of water balance and ion uptake and translocation.

10:15
Arabidopsis root nutrient acquisition responses to changing water and nitrate supply
Chapman, N.; Miller, T.; Lindsey, K.; Whalley, R.
1Rothamsted Research, West Common, Harpenden, AL5 2QJ, United Kingdom; 2John Innes Centre, Norwich Research Park, Norwich, NR4 7UH, United Kingdom; 3Durham University, South Road, Durham, DH1 3LE, United Kingdom
Studying Arabidopsis root nutrient acquisition under altered water and nitrate supply in a sand rhizotron system, Chapman et al. report root architecture and transporter responses to changing environmental conditions which indicate increased nutrient acquisition under plentiful supply.

10:30 Coffee

Function 2:
Root function and uptake
Wednesday, June 27, 2012
11:00 - 12:40
Lecture Theatre 3
Chair: K Brown, US
Co-chair: X Draye, Belgium

11:00
Modeling zinc uptake via ZIP transporters
Claus, J.; Chavarría-Krauser, A.
Interdisciplinary Center for Scientific Computing, University of Heidelberg, INF 368, Heidelberg, 69120, Germany
Zinc is transported into root cells by ZIP transporters. Their regulation is essential for zinc homeostasis, but the underlying mechanisms are largely unknown. Using a theoretical model and simulations we suggest putative models, analyze their features and identify the most likely mechanism.
**12:00**

**Auxin is involved in the responses of cluster root formation and citrate exudation to P limitation in white lupin**

Shen, J.B.; Tang, H.L.; Cheng, L.Y.; Li, X.Q.; Vance, C.P.; Zhang, F.S.

1Department of Plant Nutrition, Key Laboratory of Plant-Soil Interactions, Ministry of Education, Chi, No.2 Yuanmingyuan Westy Road, Beijing, 100193, China; 2USDA-ARS, Plant Science Research, University of Minnesota, United States

Auxin stimulates not only cluster-root formation, but also citrate exudation, indicating a role in modifying root morphological and physiological plasticity. Auxin is involved in cluster-root development as well as citrate exudation induced by P deficiency in Lupinus albus.

SS2.15

**12:20**

**Model-based analysis of resource capture by lettuce roots exposed to temporally or spatially dynamic stress**

Kerbiriou, P.J.; Lammerts van Bueren, E.T.; Struik, P.C.

1Laboratory of Plant Breeding, Wageningen UR, P.O Box 386, Wageningen, 6700 AI, Netherlands; 2Centre for Crop System Analysis, Wageningen UR, P.O Box 430, Wageningen, 6700 AK, Netherlands

Both cultivars reduced their root development in the top compartment and increased it in the lower compartment, leading to proportional nitrate capture performance similar to the control levels in the 20-30 cm. The final NUE for ‘Matilda’ was reduced by 7% while it was increased by 7% for ‘Pronto’.

SS2.16

**12:40 Lunch**
Four Dimensional Phenotyping of Gravitropism in Rice Roots and Potential Impacts on Phosphate Acquisition

Zappala, S.; Mooney, S.J.; Pridmore, T.; Bennett, M.J.

School of Biosciences, University of Nottingham, Sutton Bonington Campus, United Kingdom; Centre for Plant Integrative Biology, University of Nottingham, United Kingdom

X-ray Micro Computed Tomography (Micro CT) provides non-destructive observation of rice root architecture development in soil. Zappala et al. explore the non-destructive aspect of Micro CT and its usefulness for capturing root gravitropism in relation to phosphorus uptake.

The roots of our soils

Hinsinger, P.; Cloutier-Hurteau, B.; Jourdan, C.; Laclau, J.P.

UMR Eco&Sols, INRA, Place Viala, Montpellier, 34060, France; UMR Eco&Sols, INRA/CIRAD, Place Viala, Montpellier, 34060, France; UMR Eco&Sols, CIRAD, Place Viala, Montpellier, 34060, France

Roots of higher plants play a key role in major ecosystem support services, such as soil formation, biogeochemical cycles and habitat provision for an extremely diverse biota. We provide an overview of how roots shape the rhizosphere and ultimately the bulk of the soil.

Auxin dual action paradox and its possible role in root system shaping

Dubrovsky, J.; Ivanchenko, M.G.; Napsucialy-Mendivil, S.; Duclercq, J.; Shishkova, S.; Friml, J.; Murphy, A.S.; Benkovà, E.

Instituto de Biotecnología, Universidad Nacional Autónoma de México, Av. Universidad 2001, Col. Chamilpa, Cuernavaca, 62210, Mexico; Department of Botany & Plant Pathology, Oregon State University, Corvallis, United States; VIB Department of Plant Systems Biology, Gent University, Belgium; Purdue University, West Lafayette, United States

Microscopic examination of roots in Basal Angiosperms (ANAs and Magnoliids), Monocots, and Eudicots reveals trends in the anatomy of the vascular cylinder and cortex that supports recent molecular phylogenies of Angiosperms.

Anatomical aspects of angiosperm root evolution

Seago, J.

Biological Sciences, SUNY, College at Oswego, NY 104 West, Oswego, 13126, United States

Microscopic examination of roots in Basal Angiosperms (ANAs and Magnoliids), Monocots, and Eudicots reveals trends in the anatomy of the vascular cylinder and cortex that supports recent molecular phylogenies of Angiosperms.
16:20

The cell wall: defense reactions to abiotic stress in the root apoplast/apoplasm
Lux, A.1; Martinka, M.1; Vaculik, M.1; White, P.J.2; Bradley, M.R.3

1Department of Plant Physiology, Faculty of Natural Sciences, Comenius University in Bratislava, Mlynska dolina B2, Bratislava, SK 84215, Slovak Republic; 2The James Hutton Institute, Invergowrie, Dundee, DD2 5DA, United Kingdom; 3Plant Science Division, University of Nottingham, Sutton Bonington, Leicestershire, LE12 5RD, United Kingdom

Reactions in the apoplasm represent in many cases the key stage in defense of roots to toxic concentrations of ions, drought or wounding. Lux et al. describe specific cell wall modifications occurring after local treatment of roots, demonstrating sensitive and rapid defense of endangered root parts.

SS3.13

16:40

Differential protein expression among shoot-borne roots and their laterals
Zobel, R.

USDA-ARS, 1224 Airport Rd, Beaver, United States

In orchardgrass (Dactylis glomerata L.) electrophoretic protein gels, at least 10 differentially expressing protein bands can be found between shoot-borne roots and their component lateral roots. It is suggested that this supports the hypothesis that different root classes have different functions.

SS3.14

17:00

Root morphological and architectural characteristics of T. repens x T. uniflorum interspecific hybrids
Nichols, S.N.1; Hofmann, R.W.2; Williams, W.M.3; Crush, J.R.1

1Biological Sciences, SUNY, College at Oswego, NY 1304 West, Oswego, 13126, United States

1AgResearch, Private Bag 3123, Hamilton 3240, New Zealand; 2Lincoln University, P.O. Box 84, Lincoln 7642, New Zealand; 3AgResearch, Private Bag 11008, Palmerston North 4442, New Zealand

SS3.15
**Interaction 2: Exudates**

**Wednesday, June 27, 2012**

**09:45 - 10:30**

**Lecture Theatre 4**

Chair: P Hinsinger, France

Co-chair: G Neumann, Germany

**09:45**

**Contrasting roles of cluster roots and carboxylate exudation in nutrient cycling in young and old ecosystems**

Lambers, H.; Bishop, J.G.; Hopper, S.D.; Laliberté, E.; Zúñiga-Feest, A.  

1School of Plant Biology, The University of Western Australia, 35 Stirling Highway, Crawley (Perth), 6009, Australia; 2School of Biological Sciences, Washington State University, Vancouver, 98666, United States; 3Royal Botanic Gardens, Kew, Richmond, TW9 3AB, United Kingdom; 4Laboratorio de Ecofisiología Vegetal, Ciencias Ambientales y Evolutivas, Universidad Austral de Chile, Casilla 567, Valdivia, Chile

Cluster roots and massive carboxylate exudation in young landscapes where P is strongly sorbed, combined with shedding leaves that are rich in P, likely allows ecosystem engineering. P-mobilisation ecosystem engineering provides phosphorus for neighbouring plants lacking specialised roots.

**SKN2.2**

**10:15**

**Rhizosheath as a future breeding target for improved abiotic stress tolerance in cereals**

George, T.; Brown, L.K.; Thomas, W.T.B.; White, P.J.  

1Ecological Sciences, The James Hutton Institute, Invergowrie, Dundee, DD2 5DA, United Kingdom; 2Cell and Molecular Sciences, The James Hutton Institute, Invergowrie, Dundee, DD2 5DA, United Kingdom

Barley produces rhizosheaths of variable mass which improve tolerance to abiotic stress. Rhizosheath mass is a novel functional trait that we have used to rapidly screen populations to understand the genetic and physiological controls of cereal tolerance to phosphorus and water deficit.

**SS2.21**

**10:30 Coffee**
Detection of pH gradients in between acidifying and alkalizing roots with a novel camera/pH-sensor system

Schreiber, C.M.; Betencourt, E.; Blossfeld, S.; Souche, G.; Hinsinger, P.

1INRA, UMR Eco&Sols, Place Viala, Montpellier, France; 2Institute of Bio- and Geosciences (IBG2): Plant sciences, Research Centre Juelich GmbH, Wilhelm-Johnsen-Str., Juelich, Germany

A novel pH camera system was used to assess the pH gradient between roots and root systems of Chickpea and Durum wheat. Alkalizing (Durum wheat) and acidifying (Chickpea) effects were monitored in high resolution.

Intercropping system output relies on rhizosphere modification differing in species and soil pH

Zhang, C.C.; Liao, H.; Li, L.; Jiao, N.Y.; Shen, J.B.; Zhang, F.S.

1Plant Nutrition, China Agricultural University, NO.2 Yuanmingyuan Xilu, Haidian District, Beijing, 100193, China; 2Root Biology Center, South China Agricultural University, Guangzhou, 510642, China; 3Agronomy, Henan University of Science & Technology, Luoyang, 471003, China

The activation of unavailable nutrient causes overyielding of intercropping system. Using series of field studies across acidic and calcareous soil, Zhang et al. shows that rhizosphere modification relies on soil pH and the facilitation to maize acquiring phosphorus varies with its neighbours.

Benzoazinoids in root exudates of maize attract Pseudomonas putida to the rhizosphere

Neal, A.; Ahmad, S.; Gordon-Weeks, R.; Ton, J.

1Rothamsted Centre for Sustainable Soils and Grassland Systems, Rothamsted Research, West Common, Harpenden, AL5 2JQ, United Kingdom; 2Biological Chemistry Department, Rothamsted Research, West Common, Harpenden, AL5 2JQ, United Kingdom; 3Department of Animal and Plant Sciences, University of Sheffield, Western Bank, Sheffield, S10 2TN, United Kingdom

Benzoazinoids act as important allelochemicals in cereals. Neal et al. demonstrate that the common rhizobacterium Pseudomonas putida is able to metabolise maize BXs and is therefore resistant to BX toxicity. Furthermore P. putida is attracted to the maize rhizosphere by BXs in root exudates.

Phosphate transporter genes in mycorrhizal Brachypodium distachyon

Grønlund, M.; Clausen, S.S.; Hammer, E.; Jakobsen, I.

Department of Chemical and Biochemical Engineering, Risø Campus, Technical University of Denmark, Frederiksbergvej 399, P.O. Box 49, Roskilde, 4000, Denmark

Growth depressions in mycorrhizal B. distachyon plants are potentially caused by down-regulation of phosphate transporter genes in the direct phosphate uptake pathway. Ongoing studies examine the interplay between the direct phosphate uptake and mycorrhizal uptake pathways.
**15:15**  
*Influence of barley root exudates on community structure of ammonia oxidisers and nitrification rates in soil*  
Skiba, M.; George, T.S.; Baggs, E.M.; Daniell, T.J.

Different barley lines have varying Biological Nitrification Inhibition (BNI) ability. Using T-RFLP, we demonstrated that community structure of ammonium oxidisers differs between rhizospheres of various barley lines and the microbial production of soil nitrate is reduced under high BNI.

**15:30 Coffee**

**Interaction 3: Root-microbe interactions**  
*Wednesday, June 27, 2012*  
*16:00 - 17:20*  
*Lecture Theatre 4*  
Chair: E Baggs, UK  
Co-chair: M Wissuwa, Japan

**16:00**  
*Constraints on colonisation by arbuscular mycorrhizal fungi in pasture species in south-western Australia*  
Orchard, S.; Ryan, M.H.; Standish, R.J.; Nicol, D.

Arbuscular mycorrhizal fungi (AMF) form associations with plant roots. Investigating AMF colonisation in pasture species, Orchard et al. found no link with soil properties, but under waterlogging, AMF may be limited by host plant adaptation. DNA analysis showed distinct changes in AMF community.

**16:20**  
*Role of auxin signaling in the interaction of Arabidopsis with the plant growth-promoting bacterium Azospirillum*  
Bossuyt, S.; Spaepen, S.; Vanderleyden, J.

Azospirillum is a plant-associated auxin-producing bacterium that can exert beneficial effects on Arabidopsis. A transcriptome analysis on Azospirillum-treated Arabidopsis revealed extensive changes in gene expression of processes related to cell wall, defense and hormones.

**16:40**  
*Improving rice yield and quality through inoculation with mycorrhiza and plant growth promoting rhizo-bacteria in India*  
Srivastava, R.; Berset, E.; Mäder, P.; Adholeya, A.; Fried, P.M.; Sharma, A.K.

Microorganisms were integrated as bio-fertilizers in a wheat-rice trial in India. Four-year results show that rice grain yield was 30% higher, compared to control plots, after application of an inoculum containing mycorrhiza and rhizo-bacteria. Substantial increase of grain quality was achieved.

**17:00**  
*Nano LC-MS analysis on root secreting proteins*  

Rice roots secrete a large variety of proteins to the rhizosphere even under aseptic conditions. From nano LC-MS/MS based proteome analysis we have found that about half of them belong to PR proteins, and some of them have not reported to be expressed in rice plant.
Environment 2: Hostile conditions
Wednesday, June 27, 2012
09:45 - 11:00
Lecture Theatre 2
Chair: A Lux, Slovakia
Co-chair: A Smucker, US

09:45
Lipoamide dehydrogenase is a primary target for arsenic toxicity in plants
Chen, W.1; Taylor, N.L.2; Chi, Y.2; Millar, A.H.2; Lambers, H.1; Finnegan, PM.1
1School of Plant Biology, University of Western Australia, 35 Stirling Highway, Crawley, 6009, Australia; 2Australian Research Council Centre of Excellence in Plant Energy Biology, University of Western Australia, 35 Stirling Highway, Crawley, 6009, Australia
Lipoamide dehydrogenase has a central role in primary carbon metabolism. Finnegan et al. show that mutation of a gene encoding mitochondrial lipoamide dehydrogenase caused roots of Arabidopsis to become overly sensitive to arsenic toxicity through enhanced disruption to oxidative metabolism.

10:15
Root system distribution and root morphology of energy crop Erianthus
Shiotsu, F.1; Abe, J.2; Morita, S.3
1The college of agriculture, Ibaraki University, 3-21-1, Ami, 300-0393, Japan; 2AE-Bio, Graduate School of Agricultural and Life Sciences, The University of Tokyo, 113-8657, Japan; 3Institute for Sustainable Agro-ecosystem Services, The University of Tokyo, 1-1-1, Nishi-Tokyo, 188-0002, Japan
Erianthus spp. perform huge biomass in abandoned lands and high tolerance to environmental stresses. Shiotsu et al. examine root system distribution and root morphology of Erianthus spp. and find that they have deep root systems and possible relation to tolerance for environmental stresses.

10:30 Coffee

Environment 2: Hostile conditions
Wednesday, June 27, 2012
11:00 - 12:40
Lecture Theatre 2
Chair: A Lux, Slovakia
Co-chair: A Smucker, Slovakia

11:00
Testing the Ability of Bacteria to Colonize the Rhizosphere of Salix caprea Grown in Contaminated Soil
Fallmann, K.1; Kuffner, M.2; Puschenreiter, M.1; Sessitsch, A.2
1Department of Forest and Soil Sciences, University of Natural Resources and Life Sciences, Konrad-Lorenz-Strasse 24, Tulln, 3430, Austria; 2Bioresources Unit, AIT – Austrian Institute of Technology GmbH, Konrad-Lorenz-Strasse 24, Tulln, 3430, Austria
Bacteria do not necessarily survive when inoculated into the plant rhizosphere. Here, an approach for selecting suitable bacteria in a heavy metal-phytoextraction setup is tested and evaluated.

11:20
The adaptive responses of tall Fescue (Festuca arundinacea) growing in sand contaminated with naphthalene
Balasubramaniyam, A.1; Chapman, M.1; Rees, D.2; Harvey, PJ.1
1School of Science, University of Greenwich, University of Greenwich at Medway, Chatham Maritime, ME4 4TB, United Kingdom; 2Natural Resources Institute, University of Greenwich, University of Greenwich at Medway, Chatham Maritime, ME4 4TB, United Kingdom
Tall fescue grown in naphthalene-treated sand exhibited changes to its root structure, root growth patterns and physiology. The treated plants showed resilience to drought and xenobiotic uptake.

SS2.32

SS2.31

SS2.33
**Metal and water transport in plant roots: modelling and multiscale analysis**

Ptashnyk, M.; Chavarria Krauser, A.

1. Division of Mathematics, University of Dundee, Old Hawkhill, Dundee, DD1 4HN, United Kingdom; 2. BIOQUANT, University of Heidelberg, Im Neuenheimer Feld 267, Heidelberg, 69120, Germany

The transport of water and metal molecules is considered on the scale of a single plant root cell. We distinguish between apoplastic and symplastic pathways. Averaged model of transport processes defined on the scale of a whole root branch is derived using multiscale analysis.

**Talking Posters**

**Wednesday, June 27, 2012**

**14:45 - 15:35**

**Lecture Theatre 2**

Chair: D Vetterlein, Germany

Co-chair: I Dodd, UK

**14:45**

**Detecting change in root length density in response to nutrient patches using micro-CT**

Flavel, R.; Guppy, CN; Young, IM

University of New England, Agronomy and Soil Science, Armidale, 2351, Australia

Micro-CT techniques are able to spatially resolve and visualise root morphological changes in response to nutrient patches over small distances.

**TP01**

**14:55**

**Combining in vivo and in silico experiments to unravel root water uptake dynamics**

Lobet, G.; Couvreur, V.; Javaux, M.; Draye, X.

1. Earth and Life Institute, Université catholique de Louvain, Croix du Sud, 2 - L7-05-11, Louvain-la-Neuve, 1348, Belgium; 2. Earth and Life Institute, Université catholique de Louvain, Croix du Sud, 2 - L7-05-02, Louvain-la-Neuve, 1348, Belgium

We combined experimental (light transmission imaging in 2D rhizotrons) and modeling (R-SWMS) approaches to unravel root water dynamics. With this approach, we showed that the soil water content variations observed experimentally can not be used as a proxy of local root water uptake.

**TP02**

**A lipoxygenase gene mediates systemic root growth inhibition in Arabidopsis heterogeneously exposed to excess zinc**

Remans, T.; Vangronsveld, J.; Cuypers, A.

Centre for Environmental Sciences, Hasselt University, Agoralaan Gebouw D, Diepenbeek, Belgium

The effect of Cd and Cu on root growth is local and plants maximize the colonization and avoidance responses. In contrast, the systemic effect of Zn causes a reduced capability of Arabidopsis to colonize non-contaminated zones; a lipoxygenase gene was found to mediate this systemic effect.

**SS2.36**

**SS2.34**

**Genetic programs involved in root meristem activity or exhaustion: Lessons from a Sonoran Desert Cactaeae**


1. Departamento de Biología Molecular de Plantas, Instituto de Biotecnología - Universidad Nacional Autónoma de México, Av. Universidad 2001 Col. Chamilpa, Cuernavaca, 62210, Mexico; 2. LLIC bio, 10 Rogers St # 101, Cambridge, MA 02142, United States; 3. Genome Center, University of California, 451 Health Sciences Drive, Davis, CA 95616, United States; 4. Departamento de Biología Molecular de Plantas, Instituto de Biotecnología - Universidad Nacional Autónoma de México, Av. Universidad 2001 Col. Chamilpa, Cuernavaca, 62210, Mexico

To study meristem maintenance, differential gene expression was analyzed using RNA-seq in a cactus species with determinate root growth. Shishkova et al. suggest that there are similarities and differences in regulation of root growth and meristem maintenance in Pachycereus and Arabidopsis.

**SS2.35**

**12:20**

**A lipoxygenase gene mediates systemic root growth inhibition in Arabidopsis heterogeneously exposed to excess zinc**

Remans, T.; Vangronsveld, J.; Cuypers, A.

Centre for Environmental Sciences, Hasselt University, Agoralaan Gebouw D, Diepenbeek, Belgium

The effect of Cd and Cu on root growth is local and...
**15:05**

*Root growth and water status as studied by 3D reconstruction of MRI images*

van Dusschoten, D.; Schulz, H.; Scharroo, H.; Postma, J.A.1

1IBG-2, Plant Sciences, Forschungszentrum Juelich, Forschungszentrum Juelich, D-52425, Germany; 2AIS, University of Bonn, Bonn, Germany; 3IBG-2, Plant Sciences, Forschungszentrum Juelich, Juelich, Germany

We show MRI images of barley roots growing in soil. Novel software allows us to reconstruct the root architecture from these images for further analysis. Besides root architecture, we were able to observe the cortical senescence and the dynamics in root water status during a drying-wetting cycle.

**TP03**

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**15:15**

*Modelling the potential root water extraction ratio in soil: application to sugar cane on the Island of Réunion*

Chopart, J.L.1; Le Mézo, L.2; Vauclin, M.3

1CIRAD, Station Roujol, Petit-Bourg, 97170, Guadeloupe; 2CIRAD, Réunion; 3CIRAD, France

Using the PRER concept, defined as the ratio of the volume of soil available to roots for water uptake to the volume of soil assigned to those roots, Chopart et al. show the need to consider the spatial distribution of sugar cane root length densities and root distances in Réunion.

**TP04**

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**15:25**

*Measuring the impact of soil compaction on root system architecture*

Tracy, S.R.; Black, C.R.; Roberts, J.A.; Mooney, S.J.

University of Nottingham, School of Biosciences, Sutton Bonington Campus, College Road, Loughborough, LE12 5RD, United Kingdom

Using X-ray μCT, Tracy et al. were able to visualise and quantify the response of root systems to soil compaction in undisturbed soil in 4-D. Many morphological root characteristics were adversely affected by soil compaction, resulting in a reduced volume of soil for exploration and resource uptake.

**TP05**

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**15:30 Coffee**

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**16:00**

*Talking Posters*

Wednesday, June 27, 2012

**16:00 - 17:20**

**Lecture Theatre 2**

(Talking Posters are on display all week in the Main Hall)

Chair: D Vetterlein, Germany

Co-chair: I Dodd, UK

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**16:00**

*Influence of forest management on beech (Fagus sylvatica L.) fine root growth*

Železnik, P.; Bajc, M.; Kraigher, H.

Slovenian Forestry Institute, Veêna pot 2, Ljubljana, 1000, Slovenia

Beech fine root growth in a managed and a virgin forest stand was compared, using ingrowth soil cores and minirhizotrons. A significantly lower fine root production was observed in the managed forest than in the virgin forest stand. Fine roots growth has not stopped during winter months.

**TP06**

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**16:10**

*Dry root biomass of sugarcane grown under different lime rates in conventional and no-tillage systems*

Bolonhezi, D.; Cury, T.N.; De Maria, I.C.; Rossini, D.B.; Marconato, M.B.; Camilo, E.

1APTA Centro Leste, APTA - Research Institute of São Paulo State, Avenida Bandeirantes, 2419, Ribeirão Preto, 1403-670, Brazil; 2Centro de Solos e Recursos Agroambientais, APTA - Instituto Agronômico de Campinas, Avenida Baía de Itapura, 1428, Campinas, Graduate Student, Brazil; 3Centro de Solos e Recursos Agroambientais, APTA - Instituto Agronômico de Campinas, Avenida Baía de Itapura, Campinas, Brazil; 4UNESP, São Paulo State University, Jaboatão, Undergraduate Student - Scholarship CNPQ, Brazil

After 12 years in no-till the yield of root biomass was 1.7 Mg/ha higher than conventional tillage during the dry season. Despite the advantages of liming, it was observed significant decreased of root biomass (in average 21.4%) in function of lime rates for both tillage systems.

**TP07**
**16:20**

**RootLAB: A tree-ring based 3D root-development tool**  
Wagner, B.¹; Santini, S.²; Ingensand, H.³; Gaertner, H.⁴  
¹Plant Ecology and Ecosystem Research, University of Goettingen, Untere Karspüle, Goettingen, 37073, Germany; ²Department of Computer Science Distributed Systems, ETH Zurich, Universitätstrasse 6, Zurich, 8092, Switzerland; ³Geodesy and Photogrammetry, ETH Zurich, Wolfgang-Pauli-Str. 15, Zurich, 8093, Switzerland; ⁴Landscape dynamics, Swiss Federal Research Institut WSL, Zuercherstr 111, Birmensdorf, 8903, Switzerland

A 3D coarse-root development tool was developed, which calculates tree-ring profiles, annual growth layers and the annual volume increment. Interpolation accuracy was 9% (mean absolute percentage error) for mean ring chronologies. Total volume computations deviated by 7% from the reference model.

**TP08**

**16:30**

**Soil and roots characteristic under short rotation plantations compared to different land management practices**  
Slazak, A.; Böhm, C.; Freese, D.  
Chair of Soil Protection and Recultivation, Brandenburg University of Technology, Konrad Waschamm-Allee 6, Cottbus, Germany

Paper presents the research on carbon concentration in soil-root system of the short rotation coppice established on former arable soils compared to conventional agriculture management practices.

**TP09**

**16:40**

**Increasing the root exploitation of soil by arable cropping systems**  
Thorup-Kristensen, K.¹; Dresbøll, D.B.²; Kristensen, H.L.³  
¹Dept. of Agriculture and Ecology, University of Copenhagen, Højbakkegårds Allé 13, Tåstrup, 2630, Denmark; ²Dept. Food Science, Aarhus University, Kirstinebjergvej 10, Årslev, 5792, Denmark

A main reason for nutrient losses from arable farming is the limited soil root exploitation compared to natural plant stands. Results showed that the root exploitation was almost doubled by adding cover crops, strongly improving ecosystem services delivered by the root systems.

**TP10**

**16:50**

**High resolution X-Ray Computed Tomography (XCT) of soil and root structures**  
Keyes, S.; Grinev, D.V.; Boardman, R.P.; Mavrogordato, M.; Marchant, A.; Sinclair, I.; Roose, T.; Smyth, K.  
University of Southampton, University Rd, Southampton, SO17 1BJ, United Kingdom

Interactions between root structures and soils govern many rhizosphere processes. XCT tools, including bench-top scanners, a bespoke high-energy system, and synchrotron light sources, are being used for multi-scale investigation of soil and root interactions at resolutions down to 1µm.

**TP11**

**17:00**

**Tri-trophic belowground symbiosis between a weevil, bacteria and a desert plant**  
Rachmilevitch, S.¹; Shelef, O.¹; Helman, Y.²; Behar, A.³; Friedman, L.³  
¹Blaustein Institutes for Desert Research, Ben Gurion University of the Negev, Blaustein Institutes for Desert Research, Midreshet Ben Guriot, 84990, Israel; ²Hebrew University of Jerusalem, Israel; ³Tel Aviv University, Israel

A unique tri-trophic symbiosis taking place belowground in mud huts built on roots of a desert plant was found. Roots contribute carbon, whereas the weevil contributes nitrogen to the roots. This reciprocal interaction is possible due to nitrogen fixing bacteria harboured within the weevil’s gut.

**TP12**
## Thursday 28 June

### Lecture Theatre 3

<table>
<thead>
<tr>
<th>Time</th>
<th>Ref</th>
<th>Talk / Event</th>
<th>Presenter</th>
</tr>
</thead>
<tbody>
<tr>
<td>09:45</td>
<td>SKN1</td>
<td>Environment 3. Roots and changing environments Chaired by Stokes &amp; Fusaro Zhang</td>
<td></td>
</tr>
<tr>
<td>15:45</td>
<td>SKN51</td>
<td>A paradigm shift towards lower-nitrifying production systems – the role of Biological Nitrogen Fixation/Inhibition (BNF)</td>
<td>Guntur</td>
</tr>
<tr>
<td>16:15</td>
<td>SS51</td>
<td>&quot;Veination of rooting depth of trees, subshrub, grasses and herbs under different site conditions.&quot;</td>
<td>Loekhand</td>
</tr>
<tr>
<td>16:35</td>
<td>SS52</td>
<td>&quot;Relationship between coarse root architecture and wind-firmness in sown and planted Pinus pinaster saplings&quot;</td>
<td>Vanman</td>
</tr>
<tr>
<td>16:55</td>
<td>SS53</td>
<td>Root structure-function relationships: evidence of a &quot;root economics spectrum&quot;?</td>
<td>Roumet</td>
</tr>
<tr>
<td>17:15</td>
<td>SS54</td>
<td>Root attributes affecting water uptake of rice (Oryza sativa) under drought</td>
<td>Henry</td>
</tr>
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### Lecture Theatre 4

<table>
<thead>
<tr>
<th>Time</th>
<th>Ref</th>
<th>Talk / Event</th>
<th>Presenter</th>
</tr>
</thead>
<tbody>
<tr>
<td>09:40</td>
<td>SKN4.2</td>
<td>Root water uptake and rhizosphere dynamics</td>
<td>Carmenit</td>
</tr>
<tr>
<td>10:15</td>
<td>SS4.21</td>
<td>&quot;Visualising the root-plant and soil-water interfaces using X-ray microtomography&quot;</td>
<td>Schmidt</td>
</tr>
<tr>
<td>10:30</td>
<td>SS4.22</td>
<td>Is water availability more important for cluster root allocation than soil-P distribution?</td>
<td>Felderer</td>
</tr>
<tr>
<td>11:00</td>
<td>SS4.23</td>
<td>Horizontal root growth in Bussia indica: halotropism or nutrient trophism?</td>
<td>Shelef</td>
</tr>
<tr>
<td>11:40</td>
<td>SS4.24</td>
<td>Root distribution alters physiological responses to soil moisture heterogeneity</td>
<td>Dodd</td>
</tr>
<tr>
<td>12:00</td>
<td>SS4.25</td>
<td>Grop effects on the spatio-temporal distribution of oxygen and redox potential in the Rhizosphere</td>
<td>Ueau</td>
</tr>
<tr>
<td>12:20</td>
<td>SS4.26</td>
<td>Roots shaping ecosystem scale processes: how extreme rhizosphere oxygenation removes methane and nutrients from wetlands</td>
<td>Fritz</td>
</tr>
</tbody>
</table>

### Lecture Theatre 2

<table>
<thead>
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<th>Time</th>
<th>Ref</th>
<th>Talk / Event</th>
<th>Presenter</th>
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</thead>
<tbody>
<tr>
<td>09:40</td>
<td>TP14</td>
<td>Adventitious root formation is suppressed by strigolactones in Arabidopsis and Pea</td>
<td>Rasmussen</td>
</tr>
<tr>
<td>09:45</td>
<td>TP15</td>
<td>Adventitious root formation is suppressed by strigolactones in Arabidopsis and Pea</td>
<td>Rasmussen</td>
</tr>
<tr>
<td>10:05</td>
<td>TP16</td>
<td>How do strigolactones control nodulation on Medicago truncatula?</td>
<td>De Guyer</td>
</tr>
<tr>
<td>10:15</td>
<td>TP17</td>
<td>Can N in above- and belowground litter in stands of different tree species in northern Finland</td>
<td>Helmsaalet</td>
</tr>
<tr>
<td>10:30</td>
<td>tea/coffee (10 mins)</td>
<td></td>
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<tr>
<td>11:00</td>
<td>TP18</td>
<td>Turnover rate of Norway spruce fine roots after long-term siil warming and nutrient manipulation</td>
<td>Leppilammi-Kujansuu</td>
</tr>
<tr>
<td>11:10</td>
<td>TP19</td>
<td>Bacteria-bacterial populations are root class specific</td>
<td>Zobel</td>
</tr>
<tr>
<td>11:20</td>
<td>TP21</td>
<td>Adjacent AM geases enhance while &quot;%N addition to receiver EM% enhancement between paired pine saplings</td>
<td>He</td>
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<tr>
<td>11:30</td>
<td>TP22</td>
<td>Root distribution, morphological changes and interspecific interactions in intercropping</td>
<td>Li</td>
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<tr>
<td>11:40</td>
<td>TP23</td>
<td>Association mapping of root hair traits in rice (Oryza sativa)</td>
<td>Brown</td>
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<tr>
<td>11:50</td>
<td>TP24</td>
<td>Root growth dynamics and root architecture in wild and cultivated Aegilops-Cereals facing soil-water deficit</td>
<td>Alvarez Flores</td>
</tr>
<tr>
<td>12:00</td>
<td>TP25</td>
<td>Can root electrical capacitance be used to predict root mass in soil?</td>
<td>Dentsch</td>
</tr>
<tr>
<td>12:10</td>
<td>TP26</td>
<td>A general capacitance relationship for plant root length? – testing the Dalton Model</td>
<td>Ellis</td>
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### Lecture Theatre 3

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<tr>
<th>Time</th>
<th>Ref</th>
<th>Talk / Event</th>
<th>Presenter</th>
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<tbody>
<tr>
<td>15:40</td>
<td>SKN6.2</td>
<td>Abiotic stress elicits stimulus-specific Ca uptake signaling throughout the root system</td>
<td>Gilroy</td>
</tr>
<tr>
<td>16:15</td>
<td>SS521</td>
<td>Arabidopsis root responses to patches with nutrients: a role for external and internal cues</td>
<td>Fritz</td>
</tr>
<tr>
<td>16:35</td>
<td>SS522</td>
<td>Variability among lateral roots: Auxin and sugars interact to regulate early primordia dynamics with lateral root fate</td>
<td>Muller</td>
</tr>
<tr>
<td>16:55</td>
<td>SS523</td>
<td>Growth patterning of maize roots in the field</td>
<td>Li</td>
</tr>
<tr>
<td>17:15</td>
<td>SS524</td>
<td>Investigating root to root interactions in wheat and Arabidopsis</td>
<td>Swabreck</td>
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### Lecture Theatre 2

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<tr>
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<tbody>
<tr>
<td>15:40</td>
<td>EM03</td>
<td>Emerging methods Chaired by Watt and Dupuy</td>
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</tr>
<tr>
<td>15:45</td>
<td>EM01</td>
<td>Dynamics of root responses to water heterogeneity in soil using neutron radiography</td>
<td>Dava</td>
</tr>
<tr>
<td>16:00</td>
<td>EM02</td>
<td>Utilizing CT technology to answer unresolved questions in root research</td>
<td>Bauselle</td>
</tr>
<tr>
<td>16:15</td>
<td>EM03</td>
<td>Time-lapse scanning reveals spatial variation in tomato root elongation rates during partial waterlogging</td>
<td>Desdell</td>
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<tr>
<td>16:30</td>
<td>EM04</td>
<td>Characterization of root growth in biovers by using in situ endo copy</td>
<td>Athmann</td>
</tr>
<tr>
<td>16:45</td>
<td>EM05</td>
<td>In-situ observation and quantification of root growth by X-ray tomography - Implications on root water uptake</td>
<td>Koebnick</td>
</tr>
<tr>
<td>17:00</td>
<td>EM06</td>
<td>A field based phenotyping facility for cereal roots</td>
<td>Deegy</td>
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<tr>
<td>17:15</td>
<td>EM07</td>
<td>Green fluorescent protein (GFP), a tool to study root interactions in mixed plant stands</td>
<td>Faergt</td>
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### Lecture Theatre 3

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<th>Time</th>
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<tr>
<td>17:35</td>
<td>End of session and instructions for conference dinner dep</td>
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<tr>
<td>18:45</td>
<td>End of conference dinner - Fairmont Hotel St. Andrews</td>
<td>(please be aware of your bus pickup point)</td>
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<td>24:00</td>
<td>Return to Dundee</td>
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**Plenary Keynote**  
**Thursday, June 28, 2012**  
09:00 - 09:40  
**Lecture Theatre 3**  
Chair: H Lambers, Australia  
Co-chair: H-S Helmisaari, Finland

**Function 4: Roots in the field**  
**Thursday, June 28, 2012**  
09:45 - 10:30  
**Lecture Theatre 3**  
Chair: H Lambers, Australia  
Co-chair: H-S Helmisaari, Finland

**09:00**  
*Speeding up the delivery of root system improvements to farmers to increase crop productivity*  
Watt, M.  
CSIRO Plant Industry, GPO Box 1600, Canberra, 2603, Australia  
The challenge for researchers is to speed up use of existing root knowledge and technologies to deliver new varieties and practices to farmers faster. We integrate laboratory and field research to develop new wheats with roots for water conserving farming.

**PLK5**

**10:15**  
*Root distributions in biodiverse grasslands: spatial niche differentiation or competitive intransitivity?*  
Ravenek, J.M. (Netherlands); Mommer, L. (Netherlands); van Ruijven, J. (Netherlands); Visser, E.J.W. (Netherlands); de Kroon, H. (Netherlands), 2678, Australia  
We studied species-specific root placement and nutrient uptake in a pairwise competition experiment with eight grassland species and found some degree of competitive intransitivity, related to root traits and foraging capacity.

**SKN4.11**

**10:30 Coffee**

**Function 4: Roots in the field**  
**Thursday, June 28, 2012**  
11:00 - 12:40  
**Lecture Theatre 3**  
Chair: H Lambers, Australia  
Co-chair: H-S Helmisaari, Finland

**09:45**  
*Genotypic X environment interactions for root depth of wheat*  
Acuna, T.¹; Wade, L.J.²  
¹Tasmanian Institute of Agriculture, University of Tasmania, PB54, Hobart, 7001, Australia; ²EH Graham Centre for Agricultural Innovation, Charles Sturt University, Locked Bag 588, Wagga Wagga, 2678, Australia  
For root depth, genotype accounted for only 12% of total variance compared with 40% for G × E interaction. Differences in root growth between environments were related to a differential capacity to respond in penetration to changes in soil hardness and/or soil water content.

**SKN4.1**
11:20
The effect of inter- vs. intraspecific interactions on root growth dynamics of mature trees
Paya, A.1; Grams, T.E.2; Bauerle, T.L.3
1Horticulture, Cornell University, 159 Plant Science Building, Ithaca, 14853, United States; 2Ecophysiology of Plants, Technical University of Munich, Munich, Germany; 3Horticulture, Cornell University, Ithaca, 14853, United States
Neighborhood identity affects root growth and root interactions in a mature Norway spruce and European beech forest. Using minirhizotrons and 15N enriched nitrate, Paya et al. describe the partitioning of species’ root systems in mixture, as well as greater nitrate uptake efficiency in spruce trees.
SS4.13

11:40
Fine root dynamics in a mixed temperate forest inferred from scanner image analysis
Dannoura, M.1; Kominami, Y.2; Hattori, K.3
1Kyoto University, Kitashirakawa owake-cho, sakyō-ku, Kyoto, Japan; 2Kansai Research Center, Forestry & Forest Products Research Institute, Japan
To better understand root activities, the elongation rate and respiration rate of Quercus serrata were monitored simultaneously by combined root scanner and automatic chamber. They do not only respond to environmental parameters but are also related to the phenological stage of the trees.
SS4.14

12:00
Quantitative analysis of root distribution in pea-oat intercropping by Fourier transform infrared (FTIR) spectroscopy
Meinen, C.; Rauber, R.
Georg-August-University Goettingen, Department of Crop Sciences, Von-Siebold-Str. 8, Goettingen, 37075, Germany
We used FTIR spectroscopy to calibrate a model based on samples with specified pea and oat root ratios. The cross validated model showed a low error of cross validation (RMSECV=3.6) and a high r² (98.5). This model was used to predict species composition in root samples of intercropped pea and oat.
SS4.15

12:20
Tradeoffs for lateral root branching density in maize
Postma, J.A.1; Dathe, A.2; Lynch, J.P.3
1IBG2, Forschungszentrum Juelich, Wilhelm-Johnen-Strasse, Juelich, 52425, Germany; 2Crop systems & global change, USDA, BLDG 001 BARC-WEST, Beltsville, MD 20705, United States; 3Horticulture, PennState, Tyson Building, University Park, PA 16802, United States
We simulated the nutrient acquisition of maize root architectures varying in lateral branching density (LRBD). The optimal LRBD is greater for phosphorus than for nitrate acquisition, which shows that plants face clear tradeoffs for LRBD when optimizing the acquisition of multiple soil resources.
SS4.16
16:35
Relationship between coarse root architecture and wind-firmness in sown and planted Pinus pinaster saplings
Collin, A.1; Danquechin Dorval, A.1; Issenhuth, B.2; Meredieu, C.3; Danjon, F.3
1INRA, UMR1202 BIOGECO, F-33610 Cestas, France / Univ. Bordeaux, UMR1202 BIOGECO, F-33400 Talence, F; Cestas, 33610, France; 2INRA, UE0570 Forêts Pierroton, F-33610 Cestas, France, Cestas, 33610, France; 3INRA, UMR1202 BIOGECO, F-33610 Cestas, France / Univ. Bordeaux, UMR1202 BIOGECO, F-33400 Talence, F; 69, route d’Arcachon, Cestas, 33610, France

Architectural analysis of root system was performed in 10 paired toppled/undamaged Pinus pinaster saplings in a planted and a seeded plot 2 years after a storm. Variability of architecture is much higher in planted trees. Windthrow damage could not be attributed to a deficient root architecture.

SSS.12

16:55
Root structure-function relationships: evidence of a “root economics spectrum”?
Roumet, C.1; Picon-Cochard, C.2; Birouste, M.1; Ghestem, M.3; Stokes, A.3
1Centre d’Ecologie Fonctionnelle et Evolutive, UMR 5175, CNRS, 1919 Route de Mende, Montpellier, 34293, France; 2Unité de recherche sur l’écosystème prairial, UR 874, INRA, 234 Avenue du Brézet, Clermont-Ferrand, 63100, France; 3Botanique et bioinformatique de l’architecte des plantes, UMR T51, INRA, Boulevard de la lironde, Montpellier, 34398, France

Root structure-function relationships were examined on 75 species. We demonstrated the existence of a trade-off opposing species promoting root metabolism (high respiration rate and tissue quality) to species reducing resource loss (recalcitrant dense roots which decomposed slowly).
**17:15**

**Root attributes affecting water uptake of rice (Oryza sativa) under drought**

Henry, A.; Cal, A.J.; Batoto, T.C.; Torres, R.O.; Serraj, R.

1International Rice Research Institute (IRRI), DAPO Box 7777, Metro Manila, Philippines; 2ICARDA, Syria

Rice root structural and functional roles may differ in drought and flooded conditions. Here, the endodermis and sclerenchyma layers showed opposing responses to drought. Sap bleeding rates from the root system, root hydraulic conductance, and aquaporin expression were most affected by time of day.

**SS5.14**

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**Interaction 4:**

**Water**

Thursday, June 28, 2012

09:45 - 10:30

**Lecture Theatre 4**

Chair: M Javaux, Belgium

Co-chair: S Wilkinson, UK

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**09:45**

**Root water uptake and rhizosphere dynamics**

Carminati, A.

Georg-August University Goettingen, Busgenweg 2, Goettingen, Germany

The rhizosphere is where plants and soil meet. What are its hydraulic properties and does it affect root water uptake? We introduce a model of root water uptake coupled with the dynamics of mucilage exuded by roots. The model describes the dynamic nature of the root-soil interactions.

**SKN4.2**

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**10:15**

**Visualising the root-particle and soil-water interfaces using X-ray microtomography**

Schmidt, S1; Bengough, A G2; Gregory, P J3; Grinev, D4; Otten, W1

1SIMBIOS, University of Abertay Dundee, Bell Street, Dundee, DD1 1HG, United Kingdom; 2The James Hutton Institute, Invergowrie, Dundee, DD2 5DA, United Kingdom; 3East Malling Research, New Road, East Malling Kent, ME19 6BJ, United Kingdom; 4Engineering and the Environment, University of Southampton, Highfield, Southampton, SO 17 1BJ, United Kingdom

Root-particle and root-solution contact will be visualised and quantified for maize and lupin roots in contrasting growth media of various aggregate/particle size distribution and matric potentials using X-ray microtomography.

**SS4.21**

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**10:30 Coffee**
Is water availability more important for cluster root allocation than soil-P distribution?
Felderer, B.1; Vontobel, P.2; Schulin, R.3
1Department of Environmental Sciences, ETHZ, Universitätstrasse 16, Zürich, 8092, Switzerland; 2PSI, Villigen, Switzerland
We investigated the effect of heterogeneous water and P distribution on cluster root allocation of white lupin. In contrast to the lacking impact of localized P supply, locally increased available water capacity of soil had a negative effect on cluster root formation in the respective soil area.

Horizontal root growth in Bassia indica: halotropism or nutrient tropism?
Shelef, O.; Rewald, B.; Golan, A.; Shimon, R.
French Associates Institute for Agriculture & Biotechnology of Drylands, Ben-Gurion University of the Negev, the Jacob Blaustein Institutes for Desert Research, Midreshet Ben-Gurion, 84990, Israel
B. indica roots exhibit a unique growth of horizontal root towards salinity. Manipulating roots enhanced horizontal root development towards salinity. Sap flow measurements showed that redistribution of water is probable. Halo- and nutrient tropisms can explain the behavior of B. indica roots.

Root distribution alters physiological responses to soil moisture heterogeneity
Dodd, I.1; Puertolas, J.1; Martin-Vertedor, A.I.2
1Lancaster Environment Centre, Lancaster University, Bailrigg, Lancaster, United Kingdom; 2Comercio e Innovación de la Junta de Extremadura, Finca "La Orden" Autovía A-V, km 372 06187, Guadajira (Badajoz), Spain
Altering the proportion of the root system exposed to soil drying (by different irrigation techniques or genetic variation) alters shoot physiology (e.g. leaf growth, stomatal closure) by modifying root-to-shoot signalling.

Crop effects on the spatio-temporal distribution of oxygen and redox potential in the Rhizosphere
Uteau, D.; Pagenkemper, S.K.; Peth, S.; Horn, R.
Institute of plant nutrition and soil science, Christian Albrechts Universität zu Kiel, Hermann-Rodewald-Str. 2, Kiel, 24118, Germany
Gas diffusivity measurements and X-ray tomography were linked to root induced pore architecture leading to an improved aeration in the subsoil. The authors were able to describe oxygen gradients in the soil and in the rhizosphere, determining the importance of distribution and morphology of pores.
Roots shaping ecosystem scale processes: how extreme rhizosphere oxygenation removes methane and nutrients from wetlands

Fritz, C.†; Smolders, A.‡; Pancotto, V§; Visser, E.†
†Experimental Plant Ecology, Radboud University Nijmegen, Heyendaalseweg 135, Nijmegen 6525 AL, Netherlands; ‡Aquatic Ecology, Radboud University Nijmegen, Heyendaalseweg 135, Nijmegen 6525 AL, Netherlands; §CADIC-CONICET, B. Housay 200, Ushuaia, 9410, Argentina

Roots change soils by releasing oxygen and exudates into the rhizosphere. Comparing root density with depth profiles of methane/nutrients, Fritz et al. show how a dense root biomass causes thorough soil oxidation in the upper 2 m, cutting-off methane emissions and nutrients in Patagonian wetlands.

12:40 Lunch

Interaction 5: Root sensing of the environment
Thursday, June 28, 2012
15:45 - 17:35
Lecture Theatre 4
Chair: A Hund, Switzerland
Co-chair: PJ White, UK

Abiotic stress elicits stimulus-specific Ca²⁺ signaling throughout the root system

Choi, W.G.; Toyota, M.; Gilroy, S.
Department of Botany, University of Wisconsin-Madison, Birge Hall, 430 Lincoln Drive, Madison, Wisconsin, 53706, United States

We have characterized Ca²⁺ signals associated with exogenous stresses applied to the root system. A range of biotic and abiotic stimuli led to unique cell-type specific patterns of Ca²⁺ response that appear critical for eliciting a coordinated molecular response from the root.

16:15
Arabidopsis root responses to patches with nutrients: a role for external and internal cues

Visser, E.J.W.; Fritz, C.
Experimental Plant Ecology, Radboud University Nijmegen, Heyendaalseweg 135, Nijmegen, Netherlands

Root proliferation of Arabidopsis plants is triggered by local nutrient concentrations in the soil, but modified by the internal nutrient concentration in the plant. Together, these two cues optimize ion uptake on soils with heterogeneous distribution of nutrients.

16:35
Variability among lateral roots. Auxin and sugars interact to relate early primordia dynamics with lateral root fate

Muller, B.; Bouteillé, M.
LEPSE, INRA, 2 place Viala, Montpellier, 34060, France

We show that a link exists between the variability of lateral root fate and the dynamics of primordia development under the control of C and auxin. These features offer the maximum plasticity for the root system to face a fluctuating and challenging environment at a minimum C cost.

16:55
Growth patterning of maize roots in the field

Li, C.J.; Peng, Y.F; Niu, J.F; Yan, H.F; Ma, W; Liao, C.S; Yu, P; Zhang, Y; Ning, P; Li, X.X

It is a challenge to study root growth in the field. By six consecutive year’s field experiments, Li et al. showed that temporal and spatial distribution of maize roots in the soil during whole growth period was determined by shoot demand, N applied, and heterogeneous soil Nmin distribution.
Talking Posters
Thursday, June 28, 2012
09:45 - 10:25
Lecture Theatre 2
Chair: A Richardson, Australia
Co-chair: A Bennett, UK

09:45
Adventitious root formation is suppressed by strigolactones in Arabidopsis and Pea
Rasmussen, A.; Beveridge, C.; Geelen, D.
1University of Gent, coupure links 653, Gent, 9000, Belgium; 2The University of Queensland, Australia; 3University of Gent, Belgium
Adventitious root formation is critical for clonal propagation of important plant species. Rasmussen et al. demonstrate that the plant hormone strigolactone suppresses adventitious root formation in Arabidopsis hypocotyls and in stem cuttings of garden pea using strigolactone mutants in both species.

09:55
Bacterial succession in the wheat rhizosphere under continuous cropping
Donn, S.; Richardson, A.E.; Perera, G.; Kirkegaard, J.A.; Watt, M.
CSIRO Plant Industry, PO Box 1600, Canberra, Australia
Bacterial community structure in the wheat rhizosphere is dependent on plant stage, vicinity to the root, soil type and to some extent wheat variety. Using a combination of culturing, DNA fingerprinting and sequencing we investigated how a rhizosphere community evolved in the field over two years.

17:15
Investigating root to root interactions in wheat and Arabidopsis
Swarbreck, S.M.; Dark, A.M.; Habib, N.; Davies, J.M.
1Department of Plant Sciences, University of Cambridge, Downing Street, Cambridge, CB2 3EA, United Kingdom; 2Department of Plant Sciences, Plant Sci University of Cambridge, Downing Street, Cambridge, CB2 3EA, United Kingdom
Interactions between plants can critically affect yield. Understanding the mechanism of root-root interactions may be key to developing crop genotypes for sustainable production. Wheat root system architecture analyses were conducted and showed specific patterns dependent on the neighbour’s species.

SS5.24
10:05
How do strigolactones control nodulation on Medicago truncatula?
De Cuyper, C.; Endah, R.; Van Dingenen, J.; Goormachtig, S.
Department of Plant Systems Biology - VIB, Belgium
Strigolactones are a new class of plant hormones which are involved in many different processes of plant growth and development. We study the link between strigolactones and nodulation. Our preliminary results suggest an inhibitory role for strigolactones on nodulation.

TP16

10:15
C and N in above- and belowground litter in stands of different tree species in northern Finland
Helmisaari, H-S.; Leppälammi-Kujansuu, J.; Sah, S.; Smolander, A.
1Department of Forest Sciences, University of Helsinki, P.O.Box 27, Helsinki, 00014, Finland; 2University of Helsinki, Finland; 3Finnish Forest Research Institute, Finland
The above- and belowground litter production was determined in northern Finland. Helmisaari et al. found out that the annual fine root litter production and respective C and N inputs of birch were smaller but those of pine and spruce as large or larger than in leaf/needle litterfall.

TP17

10:30 Coffee

Talking Posters
Thursday, June 28, 2012
11:00 - 12:30
Lecture Theatre 2 (Talking Posters are on display all week in the Main Hall)
Chair: A Richardson, Australia
Co-chair: A Bennett, UK

11:00
Turnover rate of Norway spruce fine roots after long-term soil warming and nutrient manipulation
1Department of Forest Sciences, University of Helsinki, P.O. Box 27, Helsinki, 00014, Finland; 2Department of Soil and Environment, Swedish University of Agricultural Sciences, P.O. Box 7001, Uppsala, SE-75002, Sweden
Long-term soil warming and/or nutrient manipulation experiment in northern boreal forest showed the median fine root lifespan to be the lowest in a combined treatment compared to only warmed or only fertilized treatments: 48, 57 and 99 weeks, respectively.

TP18

11:10
Rhizosphere bacterial populations are root class specific.
Zobel, R.
USDA-ARS, 1224 Airport Rd, Beaver, United States
We conclude that bacterial populations in the rhizosphere are controlled by roots such that different root classes support different bacterial populations. We also conclude that this control can be genetically manipulated.

TP20

11:20
Adjacent AM grasses enhance while 14N-addition to receiver EM pines reduces 15N movement between paired pine saplings
He, X.; Horwath, W.; Bledsoe, C.; Zasoski, R.
1WA Centre of Excellence for Ecosystem Science, Edith Cowan University and University of Western Australia, 270 Joondalup Drive, Joondalup, 6022, Australia; 2Department of Land, Air and Water Resources, University of California at Davis, United States
Mechanism of nutrient movement between mycorrhizal plants is less understood. By supplying 15N to donor or 14N to receiver EM pines in the presence/absence of an AM annual grass, we found that grasses appeared to facilitate, while 14N-addition to pine receivers to reduce, N movement between trees.

TP21
11:30

**Root distribution, morphological changes and interspecific interactions in intercropping**

Li, L; Li, Q; Wang, L; Liu, N; Li, M; Zhang, F

1College of Resources and Environmental Sciences, China Agricultural University, 2 Yuan Ming Yuan Xijia, Haidian District, Beijing, 100099, China; 2China Agricultural University, Beijing, China

Interspecific interactions lead to root growth and morphological changes that derived from resource competition as well as root recognition via root exudates.

**TP22**

11:40

**Association mapping of root hair traits in rice (Oryza sativa)**

Vejchasarn, P; Lynch, J.P; Brown, K.M.

Horticulture, Penn State, 102 Tyson Building, University Park, 16802, United States

Root hairs are important for phosphorus acquisition and could be an important breeding target for rice cultivars destined for upland soils. We here describe association mapping of root hair length and density in rice.

**TP23**

11:50

**Root growth dynamics and root architecture in wild and cultivated Andean Chenopods facing soil water deficit**

Alvarez-Flores, R; Winkel, T; Joffre, R

1CNRS-CEFE, UMR 5175, 1919 route de Mende, Montpellier, 34293, France; 2IRD, CNRS-CEFE, 1919 route de Mende, Montpellier, 34293, France

In South America, wild and cultivated Chenopods are distributed from arid highlands to temperate littoral. In glasshouse experiments, Alvarez et al. demonstrate that cultivated Chenopods from drier habitats respond to soil water deficit by better soil colonization than other populations.

**TP24**

12:00

**Can root electrical capacitance be used to predict root mass in soil?**

Dietrich, R.C; Bengough, A.G; Jones, H.G; White, P.J

1The James Hutton Institute, United Kingdom; 2University of Dundee at the James Hutton Institute, Dundee, DD2 5DA, United Kingdom

Root capacitance is considered a non-invasive method for estimating root mass in soil. Capacitance correlated well with root mass, increased with local soil water content, and was closely related to shoot dimensions. The technique must be re-evaluated in the context of our results.

**TP25**

12:10

**A general capacitance relationship for plant root length? – testing the Dalton Model**

Ellis, T.W; Murray, W; Paul, K

1Land and Water, CSIRO, 41 Boggo Road, Dutton Park, Brisbane, 4001, Australia; 2Material Science and Engineering, CSIRO, Bradfield Rd, Lindfield, 2070, Australia; 3Ecosystems Services, CSIRO, Bellenden Street, Capetown, 2911, Australia

We hypothesised that root capacitance (C) was proportional to tissue density (\(\rho\)) and length (\(L^\beta\)), \(0 < \beta < 1\). In isolation, data from beans and trees supported this hypothesis. More importantly, the two data sets formed a single, strong relationship.

**TP26**

12:30 Lunch
**15:45**

*Dynamics of root responses to water heterogeneity in soil using neutron radiography*

Dara, A.; Moradi, A.B.; Oswald, S.; Carminati, A.; Vontobel, P.

1 Institute of Earth and Environmental Science, University of Potsdam, Karl-Liebknecht-Str. 24-25, Potsdam-Golm, 14476, Germany; 2 Dept. of Land Air and Water Resources, University of California, Davis, United States; 3 Institute of Earth and Environmental Science, University of Potsdam, Karl-Liebknecht-Str. 24-25, Potsdam, 14476, Germany; 4 Georg-August-University Goettingen, Goettingen, Germany; 5 Paul Scherrer Institut - PSI, Switzerland

Unequal water distribution and root growth pattern of Lupin plants in a hydraulic-partitioned soil were monitored by Neutron Radiography for two weeks. The results show an active reciprocal root response to water heterogeneity for maximum soil water utilization.

**16:00**

*Utilizing CT technology to answer unsolved questions in root research*

Bauerle, T.; Paya, A.

Horticulture, Cornell University, 134A Plant Science Bldg, Ithaca, 14853, United States

Our studies utilize recent CT scanning technologies to represent in situ, non-destructive comparison of a) root neighbor interactions between two tree seedlings and b) tree root growth over time on whole root systems of 10 maturing tree species.

**16:15**

*Timelapse scanning reveals spatial variation in tomato root elongation rates during partial waterlogging*

Dressbøll, D.B.; Thorup-Kristensen, K.; McKenzie, B.M.; Dupuy, L.; Bengough, A.G.

1 Department of Agriculture and Ecology, University of Copenhagen, Højbakkegård Allé 13, Taastrup, 2630, Denmark; 2 The James Hutton Institute, Invergowrie, Dundee, DD2 5DA, United Kingdom

Detailed information on root growth rates was obtained by consecutive scans of root chambers under semi-natural conditions. Root growth rates differed spatially after partial waterlogging. Roots within the waterlogged zone decreased growth while roots above increased growth probably to compensate.

**16:30**

*Characterization of root growth in biopores by using in situ endoscopy*

Athmann, M.; Kautz, T.; Köpke, U.

Institute of Organic Agriculture, University of Bonn, Katzenburgweg 3, Bonn, 53115, Germany

Root growth in biopores was observed using in situ endoscopy. This approach allowed detection of differences in root morphology and orientation between different plant species and to characterize pore wall properties. The current status and future perspectives of the method are discussed.
16:45
In-situ observation and quantification of root-growth by X-ray tomography – Implications on root water uptake
Koebernick, N.1; Weller, U.1; Vetterlein, D.1; Vogel, H.-J.1; Jahn, R.2
1Soil Physics, Helmholtz Zentrum für Umweltforschung - UFZ, Theodor-Lieser-Straße 4, Halle (Saale), 06120, Germany; 2Institut für Agrar- und Ernährungswissenschaften, Martin-Luther-Universität Halle-Wittenberg, Von-Seckendorf-Platz 3, Halle (Saale), 06120, Germany
Dynamic change of root system architecture (RSA) is a key for understanding water and nutrient acquisition by plants. Koebernick et al. show that X-ray tomography is a suitable tool for temporally resolved non-destructive and quantitative analysis of RSA.
EM05

17:00
A field based phenotyping facility for cereal roots
Deery, D.1; Wasson, A.P.2; Hunt, J.1; Cavanagh, C.2; Richard, R.2; Watt, M.2
1Plant Industry, High Resolution Plant Phenomics Centre, CSIRO, Black Mountain Laboratories, Black Mountain, 2601, Australia; 2Plant Industry, CSIRO, Black Mountain Laboratories, Black Mountain, 2601, Australia
Describes the development of a field-based phenotyping facility to identify root system traits for improved crop performance in wheat.
EM06

17:15
Green fluorescent protein (GFP), a tool to study root interactions in mixed plant stands
Faget, M.1; Herrera, J.M.2; Liedgens, M.2; Frossard, E.2; Stamp, P.3
1Forschungszentrum Jülich, Forschungszentrum Jülich, 52425 Jülich, Germany; 2ETH Zurich, Eschikon 33, CH-8315, Lindau, Switzerland; 3ETH Zurich, Universitätstr. 2, CH-8092, Zurich, Switzerland
Maize expressing fluorescent protein was cultivated with neighbor in living mulches. Minirhizotron system specially developed allows studying the relative distribution of roots for each plant type and their interaction with each other. Roots of maize did not preferentially grow to avoid interactions.
EM07
<table>
<thead>
<tr>
<th>Time</th>
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<th>Talk / Event</th>
<th>Presenter</th>
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<tbody>
<tr>
<td>09:10</td>
<td>RUK</td>
<td>Plenary Keynote, Chaired by Lynch and Thornton-Kürtzsen: Roots for future sustainable production</td>
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<tr>
<td>09:50</td>
<td>RUK</td>
<td>Plenary Keynote: Maximizing root/rhizosphere efficiency for improving crop productivity and nutrient use efficiency</td>
<td>Zhang</td>
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<td>10:30</td>
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<td>Tea/coffee (30 mins)</td>
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<td>11:00</td>
<td>R2.1</td>
<td>Genetic and physiological factors controlling root growth under P deficiency in rice</td>
<td>Wisswa</td>
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<td>11:20</td>
<td>R2.2</td>
<td>Plant-drawn mitigation of nitrous oxide in the rhizosphere</td>
<td>Bagg</td>
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<td>11:40</td>
<td>R2.3</td>
<td>Progress on development of forage plant root systems for sustainable New Zealand pastures</td>
<td>Gough</td>
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<td>12:00</td>
<td>R2.4</td>
<td>Drought effect on teak tree (Tectona grandis) roots on carbon inputs and water uptake in a deep soil of northern Laos</td>
<td>Maught</td>
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<td>12:20</td>
<td>RJK</td>
<td>Plenary Keynote: Roots to the future and routes to sustainability</td>
<td>Gregory</td>
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<td>13:00</td>
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<td>Lunch</td>
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<td>Optional visits to James Hutton Institute, Invergowrie; The Old Course St. Andrews Greenkeeper tour, or The University of Dundee Botanic Garden</td>
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**Plenary Keynote**
Friday, June 29, 2012
09:10 - 10:30
Lecture Theatre 3
Chair: J Lynch, US
Co-chair: K Thorup-Kristensen, Denmark

09:10
*Fine roots and soil carbon in boreal forests*
Helmisaari, H.S.
Department of Forest Sciences, University of Helsinki, PO. Box 27; Helsinki, 00014, Finland
The keynote presentation of H-S. Helmisaari will concentrate on the recent research results for understanding the role of roots in boreal forest soil C cycling, especially concentrating on C allocation and its controls.

**Plenary Keynote**

09:50
*Maximizing root/rhizosphere efficiency for improving crop productivity and nutrient use efficiency*
Zhang, F.S.; Shen, J.B.; Yuan, L.X.; Mi, G.H.; Li, L.; Li, C.J.; Chen, X.P.; Chen, F.J.
Key Laboratory of Plant-Soil Interactions, China Agricultural University, No.2 Yuanmingyuan West Road, Beijing, 100193, China
How to achieve high nutrient-use efficiency and high crop productivity through maximizing root/rhizosphere efficiency has become a challenge in intensive agriculture. Rhizosphere management can be achieved by optimizing nutrient supply, modifying root traits and manipulating rhizosphere processes.

10:30 Coffee

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**Roots for future sustainable production**
Friday, June 29, 2012
11:00 - 13:00
Lecture Theatre 3
Chair: J Lynch, US
Co-chair: K Thorup-Kristensen, Denmark

11:00
*Genetic and physiological factors controlling root growth under P deficiency in rice*
Wissuwa, M.1; Gamuyao, R.2; Mori, A.3; Pariasca-Tanaka, J.2; Heuer, S.2
1JIRCAS, 1-1 Ohwashi, Tsukuba, Japan; 2IRRI, Philippines
This paper reviews evidence from physiological, morphological and genetic studies as to which factors enable tolerant rice genotypes to maintain root growth and P uptake under P deficiency and identifies traits and loci to be used on breeding rice with improved tolerance to P deficiency.

11:20
*Plant-driven mitigation of nitrous oxide in the rhizosphere*
Baggs, E.M.; Morley, N.
University of Aberdeen, United Kingdom
Linking plant C flow to N₂O production and reduction in the rhizosphere.

11:40
*Progress on development of forage plant root systems for sustainable New Zealand pastures*
Crush, J.; Crush, J. R.; Ryan, D.; Nichols, S.N.
AgResearch, Private Bag 3123, Hamilton, 3240, New Zealand
Root phenotyping techniques have been developed and applied to ryegrass and white clover populations. Key aims are improved acquisition of nutrients and water. Breeding for improved root system function is achievable in ryegrass and white clover.
12:00

**Drought effect on teak tree (Tectona grandis) roots on carbon inputs and water uptake in a deep soil of northern Laos**

Maeght, J.L.; Henry des Tureaux, T.; Sengtaheuanghoung, O.; Stokes, A.; Ribolzi, O.; Pierret, A.

1UMR BIOEMCO, IRD, IRD-NAFRI BP 5992, Vientiane, Lao People’s Democratic Republic; 2NAFRI, Lao People’s Democratic Republic; 3INRA, France; 4GET, IRD-NAFRI BP 5992, Vientiane, Lao People’s Democratic Republic.

Fine deep roots are organs of foremost functional importance and bring about evidence that teak tree extracts deep water during critically dry periods. The presence of measurable amounts of deep fine roots should be taken into account when quantifying long-term carbon storage.

PL2.4

12:20

**Closing Plenary Keynote**

**Roots to the future and routes to sustainability**

Gregory, P.

East Malling Research, New Road, East Malling, ME19 6BJ, United Kingdom.

This presentation will highlight new areas of root science that offer ways of managing vegetation more effectively to deliver the many services that society demands. Interactions at the root/soil interface will be stressed.

PLK9

13:00 Close of spoken sessions followed by lunch and optional visits.
Monitor root growth by analysing Multiple Frames (images) of a root system taken at different times. Roots that overlap frames are saved as a single measurement data set for the group of images.

Trace roots manually with a mouse or by touching the screen of all-in-one computers or tablet computers.

Root morphology in function of root diameter and color: length, area, volume, and number of tips

Leaf area of seedlings grown in Petri dish

Leaf area - leaf/hypocotyl distinction

Root morphology

Topology and developmental analysis

Root overlap detection for accurate measurement

Leaf area, length and width of plants in soil

Leaf area, length and width of plants in soil

Topology, link and architecture with fractals

Developmental classification

Germination Count

Plant height and width

Previous analysis of a location can be retrieved to resume analysis of the same location at a later time simply by adding new or dead roots since the last analysis.

See analysis results summarized on screen automatically after scanning. Details are autosaved in data files.

Scan washed roots rapidly with Regent’s scanners and root positioning systems.

Analyse seedlings and leaves globally or individually (one analysis per image) (multiple analyses per image)

Software for interactive analysis of images of roots in rhizotron and soil

Trace roots manually with a mouse or by touching the screen of all-in-one computers or tablet computers.

Monitor root growth by analysing Multiple Frames (images) of a root system taken at different times. Roots that overlap frames are saved as a single measurement data set for the group of images.

The complete product family for root image analysis

Basic, Regular & Pro

Arabidopsis

Tron & Tron MF
Diurnal change of bleeding rate in saline-sodic soil rice of Northeast China
Liu, M.; Morita, S.; Abe, J.; Liang, Z.W.
1Northeast Institute of Geography and Agroecology, Chinese Academy of Sciences, China, 3195 Weishan road, high-tech. district, Changchun, Jilin, China; 2Department of Agrobiology, Faculty of Agriculture, The University of Tokyo, Japan; 3Northeast Institute of Geography and Agroecology, Chinese Academy of Sciences, China, China

Conclusions: Our results suggested that in terms of rice in saline-sodic soil of Northeast China, the best time for collecting root bleeding sap was at 5:00-6:00, and this result may lay the foundation for further research.

P004

Determination of root tissue density: method matters
Birouste, M; Zamora-Ledezma, E; Bossard, C; Roumet, C.
CNRS, Centre d’Ecologie Fonctionnelle et Evolutive (UMR 5175), 1919 route de Mende, Montpellier, 34293, France

Root tissue density is a key trait in root ecology. However comparison among studies is difficult due to the lack of a standard method. The comparison of three common methods showed that WinRHIZO underestimated root volume, while root dry matter concentration is a good proxy of root tissue density.

P005

Rooting density of three grass species and eight Lolium perenne varieties
Deru, J.; Van Eekeren, N.; Zanen, M.; De Boer, H.
1Louis Bolk Institute, Hoofdstraat 24, Diebergen, 3972 LA, Netherlands; 2Wageningen UR Livestock Research, Postbus 65, Lelystad, 8200 AB, Netherlands

Root biomass and root length density differed significantly between grass species and varieties measured in field experiments. Festuca arundinacea had more roots in the deeper soil layers than Lolium perenne and Dactylis glomerata. Diploid varieties had a higher root mass than tetraploid varieties.

P006

Poster Session 1
Tuesday, June 26, 2012
13:45-15:00
Room: 1.F06

Identification of phosphorus-responsive miRNAs in soybean roots and leaves
Jinxiang, W.; Xu, F.; Kuang, J.; Liao, H.
Root Biology Center, South China Agricultural University, Wushan, Guangzhou, 510642, China
18 P-responsive miRNAs in soybean roots and 26 in soybean leaves were determined.

P001

Effect of simulated microgravity on the development of primary roots in wild-type Arabidopsis and Auxin mutants
Migliaccio, F; Tassone, P; Fortunati, A.
National Research Council of Italy, Via Salaria Km 29,300, Monterotondo (Rome), Italy
The presentation describes the effect of simulated microgravity on the root grow pattern in wild-type Arabidopsis and in two auxin and gravitropism mutants.

P002

Soil erodibility and root growth: greater susceptibility following germination
Dumlao, M.R.; Silk, W.K.
Land, Air, and Water Resources, University of California, Davis, One Shields Avenue, Davis, 95616, United States
The impact of root growth on soil erodibility was assessed using simulated rainfall experiments. Soil erosion was higher in planted compared to fallow soil, particularly during the first week of growth, which was correlated with greater destabilization of the soil surface during shoot emergence.

P003
**Analyzing plant root distribution by computed tomography applications**
Kriston, S.; Benedek, S.; Soki, P.; Babcsan, N.; Czinkota, I.; Fenyesi, L.; Lehoczky, E.

1Institute of Environmental Management, Department of Hydrogeology and Engineering Geology, University of Miskolc, Miskolc-Egyetemváros, 3515, Hungary; 2Hungarian Institute of Agricultural Engineering, Tessedik S. u. 4., Gödöllő, 2100, Hungary; 3Bay Zoltan Nonprofit Ltd, Hungary; 4Institute of Environmental Science, Department of Soil Science and Agricultural Chemistry, Szent István University, Páter K. u. 1., Gödöllő, 2103, Hungary; 5Institute for Soil Science and Agrochemical Research, Centre for Agricultural Research, Hungarian Academy of Sciences, Hungary

Plant root distribution in soil was monitored by computed tomography measurements. Results indicate a good quality of 3D image and a good distribution of root axes and laterals for the observed plants.

**P007**

**Root growth dynamics of three beech (Fagus sylvatica L.) provenances**
Železnik, P.; Bajc, M.; Kraigher, H.

Slovenian Forestry Institute, Vešna pot 2, Ljubljana, 1000, Slovenia

Fine roots of three planted beech provenances and natural beech regeneration in ingrowth soil cores showed significant differences in necromass. Fine roots in minirhizotrons are still growing 5 years after the initiation of measurements.

**P008**

**Comparison of lucerne root characteristics under irrigated and rain-fed conditions**
Raza, A.; Friedel, J.K.; Moghaddam, A.; Ardakani, M.; Loiskandl, W.; Himmelbauer, M.; Bodner, G.

1Nuclear Institute of Agriculture, Tando Jam, Hyderabad, 70060, Pakistan; 2Sustainable Agricultural Systems, University of Natural Resources and Life Sciences, A-1180, Vienna, Austria; 3Seed and Plant Improvement Institute, Tehran, Iran, Islamic Republic of; 4Institute of Hydraulics and Rural Water Management, BOKU, Vienna, Austria; 5Institute of Agronomy and Plant Breeding, Department of Crop Sciences, BOKU, Vienna, Austria

This study compares the root biomass and root length density of three lucerne varieties under irrigated and rain-fed conditions in a two year field experiment. We found that varieties had usually higher biomass and root length density under rain-fed conditions than under irrigated conditions.

**P009**

**Absorption of carbonate acid gas by Vetiveria plants and Pampas grass within the boundaries of international corridors**
Gavardashvili, G.; Tevzadze, V.; Chakhaia, G.; Tsulikidze, L.

Water Management Institute, Georgian Technical University, 60, Ave. I. Chavchavadze, Tbilisi, 0162, Georgia, Republic of

Considering the principal geological, ameliorative, hydrological and climatic factors of the soil, the irrigation norms and the watering of Vetiver, the coefficient of evaporation and transpiration were determined, as well as dynamics of growth of the height and root system of Vetiver.

**P010**
Absorption of carbon dioxide by vetiveria plants with their root system within the boundary corridors
Gavardashvili, G.1; Tevzadze, V.; Chakhaia, G.1; Tsulukidze, L.1

1Director, Water Management Institute of Georgian Technical University, Ave, 60 I. Chavchavadze, Tbilisi, 0162, Georgia, Republic of; 2Department of Natural Disaster, Water Management Institute of Georgian Technical University, Ave, 60 I. Chavchavadze, Tbilisi, 0162, Georgia, Republic of; 3Department of Environmental Protection and Engineering Ecology, Water Management Institute of Georgian Technical University, Ave, 60 I. Chavchavadze, Tbilisi, 0162, Georgia, Republic of

Using the theory of reliability the soil antierosional effect of the so-called biological wall formed of Vetiver has been determined, taking into consideration the principal parameters of the maximum intensity of rainfall, the washout rate of the soil particles and other parameters.

Effects of soil strength on plant architecture
Lloyd, D.P.A.; Coelho Filho, M.A.; Webster, C.P.; Colebrook, E.H.; Phillips, A.L.; Hedden, P.; Whalley, W.R.

Rothamsted Research, Harpenden, AL5 2JQ, United Kingdom

The architecture of a plant can be influenced by a variety of environmental factors. Utilising sand-columns in a controlled environment, Lloyd et al. demonstrate that soil strength influences the number of tillers and leaf elongation in wheat (Triticum aestivum L.).

The coefficient of soil-root friction during soil penetration by roots of Pisum sativum
McKenzie, B.M.; Mullins, C.E.; Tisdall, J.M.; Bengough, A.G.

1The James Hutton Institute, Invergowrie, Dundee, DD2 5DA, United Kingdom; 2Private, United Kingdom; 3La Trobe University, Australia; 4The James Hutton Institute, United Kingdom

We have quantified the two separate components needed for roots to penetrate soil i.e. the cavity expansion and the soil-root friction.

Sweet sorghum root and canopy responses to water deficit occurring at different growth stages
Zegada-Lizarazu, W.1; Alessandro, Z.1; Lorenzo, N.2; Andrea, M.1

1Department of Agroenvironmental Science and Technology, University of Bologna, 44, Viale G. Fanin, Bologna, 40127, Bologna, Italy; 2University of Bologna, Italy

Regardless of the duration (20/40 days) or the growth stage (early/late) sweet sorghum has the capacity to recover its physiological activities after the plant is rewatered.

Influence of soil depth and mycorrhizal infection on rhizosphere extension
Hafner, S.1; Wiesenberg, G.L.B.; Kuzyakov, Y.1

1Department of Soil Science of Temperate Ecosystems, Georg-August University of Göttingen, Büsgenweg 2, Göttingen, 37077, Germany; 2Department of Agroecosystem Research, University of Bayreuth, Bayreuth, 95440, Germany

Rhizosphere extension was higher in subsoil than in topsoil treatment excluding mycorrhizal influence. Mycorrhizal hyphae had no influence on rhizosphere extension in subsoil, whereas hyphal transport of C increased the spatial influence of roots in the topsoil treatment.

Roots to Variety: ML365, A deep root introgressed finger millet variety for drought and food security in India
Hittalmani, S.; Rao, A.M.; Selvi, G.A.

Genetics and Plant Breeding, University of Agricultural Sciences, College of Agriculture, GKV, Bangalore, 560065, India

Deep-rooted fingermillet introgressed lines developed and evaluated for grain yield under moisture stress indicated ML365 genotype with 135 cm root depth, 6 tons grain yield with 45 days stress. This is success story of role of roots for food security crop.
Linkages between plant functional composition, root traits and soil N cycling in Mediterranean grasslands
Zamora-Ledezma, E.; Fromin, N.; Blanchard, A.; Roumet, C.
Département d’Ecologie Fonctionnelle, CNRS, Centre d’Ecologie Fonctionnelle et Evolutive (UMR 5175), 1919 Route de Mende, cedex 5, Montpellier, 34293, France
Root traits can be modified by environmental conditions and plant diversity. In return they could alter soil processes. Zamora-Ledezma et al. analyzed above and belowground diversity and processes and found that root functional traits responses are related to the acquisition—conservation trade-off.

Modelling of rhizospheric pH based on plant mineral nutrition
Custos, J.M.; Moyne, C.; Blossfeld, S.; Sterckeman, T.
1ENSAIA, INPL-INRA, 2, avenue de la Foret de Haye - BP 172, Vandoeuvre-les-Nancy cedex, 54505, France; 2ENSEM, Nancy Université, CNRS, 2, avenue de la Foret de Haye - BP 160, Vandoeuvre-les-Nancy cedex, 54504, France; 3Forschungszentrum Juelich, IBG-2, Plant Sciences, Juelich, 52425, Germany
The nutrients concentrations in soil solution were driven by desorption from solid phase and their transport towards the root by diffusion and convection. When more anions entered the root than cations an equivalent charge flux (HCO$_3^-$ and OH$^-$) left the root and consecutively the soil was alkalinized.

Root architecture of Atlas pistachio in relation with its underlying soil properties in arid area (Algeria)
Limane, A.; Smail-Saadoun, N.
Biologie Animale et végétale, Mouloud Mammeri University, 15000, Hasnaoua, Tizi-Ouzou, Tizi-Ouzou, Algeria
In arid areas, the root system of the Atlas pistachio evolves according to the physicochemical characteristics of the underlying soil. Young pistachio installs quickly a shallow root network. With age, it prospects deep “reservoir-levels” by issuing many tap roots that also allow it a best anchorage.

Local landraces of rice from Sri Lanka: variation in alleles and traits related to drought resistance
Munasinghe, M.; Price, A.H.
Department of Plant and Soil Science, University of Aberdeen, Cruickshank Building, St. Machar Drive, Aberdeen, AB24 3UU, United Kingdom
Three genotypes (Podi wee, Sinnavellai and Niyan wee) were revealed as the most deep-rooting drought-resistant landraces using three root screening methods: herbicide screening, hydroponics and rhizotrons. The herbicide scores significantly co-correlated with the drought scores in IRRI database.

A conceptual model of root hair ideotypes for future agricultural environments
Brown, L.; George, T.S.
Ecological Sciences, The James Hutton Institute, Invergowrie, Dundee, DD2 5DA, United Kingdom
We present a conceptual model that has been developed to enhance understanding of interactions between the production of root hairs by plants and phosphorus acquisition. Furthermore potential root hair ideotypes are identified which represent breeding targets for future agricultural environments.

Identity and diversity effects on fine root biomass and morphology of temperate deciduous tree species
Kubisch, P.; Jacob, A.; Hertel, D.; Leuschner, C.
Albrecht von Haller Institute for Plant Sciences, Plant Ecology, University of Goettingen, Untere Karspuele 2, Goettingen, 37073, Germany
Biodiversity often is suggested to be the key for productivity in plant communities. In our studied mature deciduous broad-leaved tree species there were no biodiversity effects on fine root biomass, so we conclude that species identity plays the major role in soil occupation by fine roots.
Initational root development of Jatropha curcas L. seedlings under three different substrates
Valdes-Rodriguez, O.A.; Sanchez, O.; Angeles, P;
Caplan, J.S.; Danjon, F
1Centro de Investigaciones Tropicales, Priv de Araucadias sn, Xalapa, 91000, Mexico; 2Inecol, Xalapa, Mexico; 3Rutgers University, United States; 4NRA, Pierroton, France
Jatropha curcas seedlings developed better in loam soils compared to clay and sandy soils. Scanning electron microscope images and WinRHIZO analysis showed higher root development in loam soils.

P023

Relations between root survivorship and root diameter, soil depth and birth season in a perennial alpine meadow
Cui, X; Wu, Y
1College of Life Science, Graduate University of the Chinese Academy of Sciences, Yuquanlu A19, Beijing, China; 2Department of Environmental Engineering, Ningbo University, China
Root life span was positively correlated with root diameter. An increase of diameter of 0.1 mm decreased mortality risk by 125 %. Roots in surface 10 cm soil layer had significantly shorter longevity. Of all the factors examined, root birth season had the strongest effects on root life span.

P024

Root development and soil fertility in the root zone of rice under flooded and aerobic conditions in Northeast Thailand
1Graduate School of Agriculture Kyoto University, Japan; 2Graduate School of Agricultural and Life Science, The University of Tokyo, Japan; 3Ubon Rachathani Rice Research Center, Thailand
A core sampler allowing soil sampling with the distance from a hill was applied to aerobic and flooded paddy fields in Northeast Thailand. Soil analyses suggested that root growth was limited by phosphorus and that its availability was increased by an increase of pH around a hill.

P025

Modeling tree rooting depth and distribution from incomplete profile root biomass data
Starr, M.; Helmisaari, H-S.; Merilä, P
1Department of Forest Sciences, P.O. Box 27, Helsinki, FI-00014 University of Helsinki, Finland; 2Finnish Forest Research Institute, PO Box 413, University of Oulu, 90014, Finland
Non-linear functions were fitted to fine-root biomass data for Scots pine and Norway spruce stands in Finland. The aims were to test for differences in function parameters between the two species and whether they could be used to define depth for use in calculating soil water storage capacity.

P026

Response of rhizosphere characteristics of two different P-efficiency wheat genotypes to the various P sources
Zhang, S.; Zhan, X.
1Institute of Agricultural Resources and Regional Planning, Chinese Academy of Agricultural Sciences, 12 ZhongGuanCun NanDajie, Beijing, China; 2Institute of Agricultural Resources and Regional Planning, Chinese Academy of Agricultural Sciences, China
The mechanism of the P-efficient wheat genotypes to adapt to P deficiency would also depend on the phosphorus sources with a sparing solubility in the substrate, especially inorganic or organic forms, in addition to available levels.

P027

Root exudates of wheat cultivars change the soil microbial community and humic acid structure
Polonskaya, D.; Polonskiy, V
1Krasnoyarsk State Agrarian University, Mira str., 90, Krasnoyarsk, 660049, Russian Federation; 2Krasnoyarsk State Agrarian University, Russian Federation
It was shown that the root exudates change the direction of microbiological processes of conversion of nutrients and humus in soil. In consideration with influence of root exudates of plants, preference must be given to cultivars, which give big crop yields and excludes the utilization of nitrogen.

P028
Root growth of watermelon grown in different methods of tillage

Branco, R.B.F.; Nowaki, R.H.D.; Salles, F.A.; Bolonhezi, D.; Suguino, E.; Suguino, E.

1Horticultural, Agência Paulista de Tecnologia dos Agronegócios (APTA), Av. Bandeirantes, 2491 Ribeirão Preto, 14030-070, Brazil; 2Universidade de Marília - UNIMAR, Av Rua Hygino Muzy Filho, Marília, 1725-902, Brazil

Root growth is important characteristic to evaluate plant performance in field. Using images from root scanner we verified that watermelon had a great root growth in no-tillage after lupine and in a minimum tillage in both, oat and lupine cover crops, compared with conventional tillage.

P029

Plant Defense Alteration against Insect Pest through Activation of Plant-Root Secondary Metabolism under Gravisensing

Marabi, R.S.; Satpute, G.K.; Singh, Y.; Mishra, S.

1Entomology, Jawaharlal Nehru Agricultural University, College of Agriculture, Tikamgarh, 472 001, India; 2Plant Breeding & Genetics, Jawaharlal Nehru Agricultural University, College of Agriculture, Tikamgarh, 472 001, India; 3Plant Breeding & Genetics, Jawaharlal Nehru Agricultural University, College of Agriculture, Tikamgarh, 472 001, India; 4Plant Breeding & Genetics, Jawaharlal Nehru Agricultural University, College of Agriculture, Jabalpur, 482 004, India

TCH-4 gene encodes a xyloglucan endotransglycosylase (XET) that ensures cell wall reinforcement. A recombinant brassinosteroid protein acts as a XET. Cytochrome P450 is a gravity-regulated gene responsible for secondary metabolites elaboration and involved in brassinosteroid biosynthesis.

P030

The differential effect of nutrient deficiencies on the root morphology of Arabidopsis thaliana

Gruber, B.D.; Giehl, R.F.H.; von Wirén, N.

Molecular Plant Nutrition, Leibniz Institute of Plant Genetics and Crop Plant Research (IPK), Corrensstrasse 3, Stadt Seeland, OT Gatersleben, 06466, Germany

Nutrient deficiencies influence root morphology in ways that are specific for some nutrients. However, for other nutrients roots respond similarly to a number of deficiencies. This comprehensive study details the response of Arabidopsis to the deficiency of more than 10 different nutrients.

P031

The Arabidopsis NRT1.1 gene acts as a NO₃⁻ sensor and governs root colonization via local modification of auxin fluxes

Bouguyon, E.; Perrine-Walker, F.; Krouk, G.; Mounier, E.; Pervent, M.; Gojon, A.; Nacry, P.

INRA, B&PM; IBIP, 2 place viala, Montpellier, 34060, France

The Arabidopsis NRT1.1 gene enables the plant to detect local NO₃⁻ concentration and modulates RSA. It stimulates root proliferation in high NO₃⁻ patches by regulating the expression of the MADS box TF, ANR1 and represses root growth under NO₃⁻ depletion by preventing auxin accumulation in primordia

P032

Root structural responses to cadmium and copper pollution

Tarshis, L.G.; Budkevich, T.A.

1Ecology Department, Pedagogical University of Ekaterinburg, Belorechenskay street, number 9/4, 72 Ekaterinburg, 620102, Russia; 2V. Kuprevich Institute of Experimental Botany of National Academy of Sciences of Belarus, Academicheskaya, 27, Minsk, 220072, Belarus

Roots can be used for indication of pollution soil by heavy metals. In conditions of pollution in roots radial symmetry and differentiation of elements secondary phloem and xylem is broken.

P033
Metabolite profiling of Komatusna (Brassica rapa L.) field-grown under different soil organic amendment and fertilisers
Okazaki, K.; Shinano, T.; Oka, N.; Takebe, M.1
1Agro-environmental Research Division, NARO Agricultural Research Center, Toyohira-ku, 1 Hitsujigaoka, Sapporo, 062-8555, Japan
Metabolite profiling was carried out using GC/MS in Brassica rapa L. The three most significant factors were N absorption, manure amendments and slow release N. Current findings will serve to direct further studies on the relationship between plant and soil environments.
P034

Cadmium stress and rootstock influence on antioxidant responses in tomato grafted plants
Azevedo, R.A.; Gratão, P.L.
University of São Paulo, Departamento de Genética, ESALQ, Av. Padua Dias, Piracicaba, 13418-900, Brazil
Uniform tomato plants were grafted with distinct combinations among rootstocks and scions with combination of Cd concentrations. The results revealed that the responses obtained were much more dependent upon Cd presence in the rootstock than scions exposed to Cd.
P035

Maize nodal root growth response to water deficits: Characterization in a divided-chamber model system
Riggs, K.J.; Sharp, R.E.
Division of Plant Sciences, University of Missouri, Columbia, 1-31 Agriculture Building, Columbia, Mo 65211, United States
A divided-chamber system was developed to characterize the nodal root growth response to water deficits in maize. The system models the field situation, in which upper soil layers dry, to enable studies of nodal root growth regulation under a range of steady-state and reproducible conditions.
P036

Root Structure and Development in Rootless Maize Mutant lrt1
Husáková, E.; Soukup, A.
Department of Experimental Plant Biology, Charles University in Prague, Faculty of Science, Vinicná 5, Prague 2, 128 44, Czech Republic
Detailed anatomical analysis of the root system of lrt1 (lateral rootless1) maize mutant under different conditions of cultivation is presented.
P037

Fine root morphology of four tree species at two different managed agroforestry sites
1Chair of Organic Farming and Agronomy, Technische Universität München, Alte Akademie 12, Freising, 85354, Germany; 2Chair of Ecophysiology of Plants, Technische Universität München, Hans-Carl-von-Carlowitz-Platz 2, Freising, 85354, Germany
Fine root morphology influences nutrient and water uptake. This study shows that the fine root parameters (root length density, specific root length, branching) and intensity of space occupation differs between four tree species as well as between the two management systems.
P038

Extended exposure to NaCl stress influences growth, root parameters and ion content in faba bean seedling
Cao, J.; Li, X.T.; Dong, L.P.
School of Life Sciences, Lanzhou University, School of Life Sciences, Lanzhou University, Lanzhou 730000, PR. of China, Lanzhou, China
Effect of extended exposure to 0.1%NaCl increment every week could stimulate growth of faba bean seedling, especially in roots development, but higher salt concentration inhibited their growth. K+/Na+ ratio in shoot increased with the extended treatment, but did not affect in root.
P039
**Effects of silicon on root growth and root exudates of rice under cadmium and zinc stress**

Wen, X.; Cai, K.

College of Agriculture, South China Agricultural University, Wushan Road, Tianhe District, Guangzhou, Guangzhou, 510642, China

Si plays an important role in enhancing heavy metal tolerance of plants. Our studies demonstrate that Si-alleviated Cd or Zn toxicity in rice is associated with an increase in phenols concentrations of root exudates and maintaining integrity of cell structure of root.

**P040**

**Effect of nitrogen fertilizer form on root system structure in regrowth of first-year alfalfa**

Hirose, D.; Tatsumi, J.

1Environmental Horticulture, Minamikyusu University, 3764-1 Tateno-cho, Miyakonojo, 885-0035, Japan; 2Center for bioresource filed science, Kyoto institute of technology, 1 Sagaippongichou Ukyouku, Kyoto, 636-8354, Japan

Superior recovery in root length during regrowth stage of alfalfa plants fertilized with ammonium-N compared to plants fertilized with nitrate-N was found. This was associated with changes in fractal dimension and lacunarity of root system structure.

**P041**

**Pedogenic carbonate formation is enhanced by rhizosphere activity**

Gocke, M.; Pustovoytov, K.; Kuzyakov, Y.

1Department of Agroecosystem Research, University of Bayreuth, Universitätsstr. 30, Bayreuth, 95440, Germany; 2Institute of Soil Science and Land Evaluation, University of Hohenheim, Emil-Wolff-Str. 27, Stuttgart, 70599, Germany; 3Department of Soil Science of Temperate and Boreal Ecosystems, University of Göttingen, Büsgenweg 2, Göttingen, 37077, Germany

Pedogenic carbonates as important carbon pool of arid regions, are suggested to form during millennia. 14C labeling experiments showed that carbonate recrystallization occurs much faster in rhizosphere, indicating the role of plants for acceleration of PC formation and carbon sequestration in soil.

**P042**

**Time-lag in root-shoot growth of ash seedlings after the two disturbances during growing period**

Takayoshi, K.; Mao, Q.; Kitao, M.

1Forest Science, Hokkaido University, Kita9 Nishi9 Kita-ku, Sapporo, 0608589 Japan; 2Tree Physiology, Forestry and Forest Products Research Institute, Hitsujigaoka 7, Sapporo, 0620045, Japan

Root-shoot growth of regenerated ash seedlings was monitored after canopy-gap formation at July and Sept. in three successive years. July gap-formation accelerated root growth without fine roots in first year but autumn one did not. The pattern of root-shoot was characterized by ring porous wood.

**P043**

**Root-shoot growth of ash seedling after the disturbances during growing period**

Takayoshi, K.

Forest Science, Hokkaido University, Kita9 Nishi9 Kita-ku, Sapporo, 0608589 Japan

Root-shoot development of regenerated ash seedlings was monitored with the top canopy opening in early summer and autumn during three successive growing seasons. Early summer opening accelerated intensive root development in first year but autumn one did not.

**P044**

**Ecosfix – Ecosystem services provided by root systems**

Prieto, I.; Kim, J.; Roumet, C.; Stokes, A.

1Ecologie Fonctionnelle, Centre d’Ecologie Fonctionnelle et Evolutive - CNRS, 191B, Route de Mende CEDEX 5, Montpellier, 34293, France; 2UMR-AMAP, Montpellier, France; 3INRA, Montpellier, France

We will investigate the supporting and regulating services that plant root systems can provide in different ecosystems and in particular, focus on the functional importance of deep roots with regard to shallow roots and their role, function and form at an ecosystem level.

**P045**

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**Poster Session 1**

**Room 1.F06**
**Poster Session 1**

**Root Discrimination Of Crop And Weed Species By Fourier Transform Infrared (FTIR) Spectroscopy**

Meinen, C.; Rauber, R.
Department of Crop Sciences, Georg-August-University Göttingen, Agronomy, Von-Siebold-Str. 8, Göttingen, 37075, Germany

We used FTIR-ATR spectroscopy to discriminate roots of crop and weed species. Spectral pattern of roots differed depending on species. Cluster analyses of root spectra revealed a successful discrimination of even closely related species. 

**P047**

**Application of a DNA-based method to measure the root growth of perennial grasses in an acid soil**

Haling, R.E.1; Simpson, R.J.2; Culvenor, R.A.2; Lambers, H.3; Richardson, A.E.2
1School of Environmental and Rural Science, University of New England, Armidale, 2351, Australia; 2CSIRO Plant Industry, PO Box 1600, Canberra, 2601, Australia; 3School of Plant Biology, University of Western Australia, 35 Stirling Highway, Crawley, 6009, Australia

Measuring root growth in the field is difficult due to the spatial heterogeneity of roots and the potential loss of roots during sampling. This paper demonstrates the application of a DNA-based method to investigate the root growth of perennial pasture grasses varying in acid-soil resistance. 

**P048**

**Root biomechanics depend on root type and on soil abiotic stresses**

Loades, K.; Bengough, A.G.; Hallett, P.
The James Hutton Institute, Errol Road, Invergowrie, DD2 5DA, United Kingdom

Abiotic stress influenced maximum root length. Root type influenced greatly the relationship between root diameter and root tensile modulus and strength. Separation of different root types improves our ability to model root tensile strength and stiffness. 

**P049**

**Genes involved in carbon partitioning in maize and their effects on roots**

1Agronomy, Purdue University, 915 W. State Street, Lilly Hall of Life Sciences, West Lafayette, IN 47907-2054, United States; 2Division of Biological Sciences, University of Missouri, 105 Tucker Hall, Columbia, MO 65211-7400, United States

The data suggest either that Sut1 may not play a role in sink strength or that its role is redundant with other proteins. The effects of tdy1 mutation on root growth are presented suggesting a direct effect on root growth and that tdy1 may play a role in determining sink strength in roots. 

**P050**

**Root characteristics of lucerne under rain-fed conditions**

Raza, A.; Friedel, J.K.; Moghaddam, A.; Ardakani, M.R.; Loiskandlityty, W.; Himmelbauer, H.; Bodner, G.
1Nuclear Institute of Agriculture, Tando Jam, Hyderabad, 70060, Pakistan; 2Division of Organic Farming, Department of Sustainable Agricultural Systems, Vienna, Austria; 3Seed and Plant Improvement Institute, Tehran, Iran, Islamic Republic of; 4Division of Sustainable Agriculture, Agriculture Research Center, Islamic Azad University, Karaj, Iran, Islamic Republic of; 5Institute of Hydraulics and Rural Water Management, University of Natural Resources and Life Sciences, Vienna, Austria; 6Institute of Hydraulics and Rural Water Management, University of Natural Resources and Life Sciences, Vienna, Austria; 7Institute of Agronomy and Plant Breeding, Department of Crop Sciences, University of Natural Resources and Life Sciences, Vienna, Austria

This study compares root biomass and root characteristics of six lucerne varieties under rain-fed conditions in a field experiment in Eastern Austria. We identified two varieties Ordobad and NS-banan as a suitable choice for rain-fed organic farming conditions on account of their high root yields. 

**P051**
Influences of root circling on the growth of Ligustrum obtusifolium and Quercus myrsinifolia seedlings
Yamashita, M.1; Ito, N.2
1Kyushu-Okinawa Agricultural Research Center, 1823-1 Mii-machi, Kurume, 839-8503, Japan; 2Green Support Co. Ltd, Japan
The root circling noticeably restrained the top and root growth of tree seedlings raised in containers. This was concluded to result in less formation of active fine roots in the seedlings. The root egress ability and biodegradability of containers might improve the growth after transplanting.
P052

Effects of sand dune encroachment on the growth of two salix species in inner Mongolia, China
Teraminami, T.1; Nakashima, A.2; Ominami, M.2; Yamamoto, M.3; gou Shen, Z.4; Yoshikawa, K.1
1Graduate School of Environmental Science, Okayama University, 1-1-1 Tsushima-machi, Kita-ku, Okayama-shi, 700-0811, Japan; 2Graduate School of Systems Engineering, Wakayama University, 640-8444, Japan; 3Wakayama Pref, Japan; 4Inner Mongolia Agricultural University, China
S. psammophila grows adventitious roots from the part of the main shoot that has been engulfed by sand, and the biomass of the aboveground part increases with the increase in the number and biomass of adventitious roots from the engulfed main shoot.
P053

The Dynamics of Paddy Rice Roots in Organic Farming
Tajima, R.; Kamo, K.; Tsushima, K.; Mashiko, A.; Ito, T.; Saito, M
Field Science Center, Tohoku University, Yamogida, Naruko-onsen, Ohsaki, 989-6711, Japan
Root dynamics of rice in organic farming is important but unclear. With ingrowth core method, production and mortality of roots were estimated. The production and mortality of roots were high in organic farming. The production of roots was accelerated by PolySilicate-Iron sludge.
P054

Mapping tree root distribution for improved belowground analysis in an agroforestry site using ground penetrating radar
Borden, K.A. 1; Isaac, M.E.2; Thomas, S.C.1
1Faculty of Forestry, University of Toronto, Canada; 2Department of Physical and Environmental Sciences, University of Toronto, Canada
Ground penetrating radar is being used to determine distribution of tree roots in an agroforestry site in southern Ontario, Canada. Tree root systems will be assessed using root distribution data and tree root carbon content analysis.
P055

Field measurement of root growth of winter wheat and fodder radish before winter using different methods
Wahlström, E.M.; Munkholm, L.J.; Hansen, E.M.
Agroecology, Aarhus University, P.O. Box 50, Tjele, DK-8830, Denmark
Root development before winter in catch crops and cash crops are essential in relation to nitrogen uptake and thus controlling the nitrogen leaching problem. We investigated different methods to assess root density and depth in the field for winter wheat and a fodder radish catch crop.
P056

Angle of root crossed scanning line is important for root detection with ground penetrating radar
Dannoura, M.1; Hirano, Y.2; Tanikawa, T.2; Yamase, K.4; Aono, K.5; Igarashi, T.5; Ishii, M.5; Kanazawa, Y.6
1Kyoto University, Kitashirakawa oiwake-cho, sakyo-ku, Kyoto, 606-8502, Japan; 2Graduate School of Environmental Studies, Nagoya University, Nagoya, 464-8601, Japan; 3Kansai Research Center, Forestry and Forest Products Research Institute, Japan; 4Hyogo Prefectural Technology Center for Agriculture, Japan; 5The General Environmental Technos Co., Ltd. (KANSO TECHNOS), Japan; 6NPO, Japan
To detect the root underground using nondestructive ground-penetrating radar, the effect of angle and diameter were tested. The relationship between diameter/angle and strength of reflected wave were shown as a sine curve formula.
P057
Root growth dynamic in relation to aerial growth and phenology in sweet cherry trees on a semi-dwarfing rootstock II
Artacho, P.; Bonomelli, C.
1Programa Postgrado En Ciencias De La Agricultura, Pontificia Universidad Catolica De Chile, Vicuña Mackencia 4860, Santiago, 7820436, Chile; 2Departmento De Fruticultura Y Enologia, Pontificia Universidad Catolica De Chile, Vicuña Mackenna, Santiago, 7820436, Chile
Information about root growth patterns is important for optimization of nutrient management. Using rhizotrons installed in a high density orchard at central Chile, common features were found in root growth patterns across three seasons, reflecting a primary dependency on photosynthate availability.

P058

Variation of seedling root traits in wild barley (Hordeum vulgare L. ssp. spontaneum) germplasm
Yun, S.J.; Tyagi, K.; Lee, H.J.; Steffenson, B.J.; Lee, K.J.
1Department of Crop Science, Chonbuk National University, Jeonju, 561-756, Korea, Republic of; 2Chonbuk National University, Jeonju, 561-756, Korea, Republic of; 3Department of Plant Pathology, University of Minnesota, St. Paul, United States; 4Division of Biotechnology, Chonbuk National University, Korea, Republic of
Several WBDC accessions from Jordan and Syria exhibited several favorable root traits like highest RL, SRL, and few SRN and may be useful in breeding for drought conditions. Accessions WBDC266, WBDC302, WBDC286 and WBDC241 had the longest RL, highest RW, SDRW and SRL, respectively.

P059

Roots of legumes on soils with different texture in organic farming
1Chair of Organic Agriculture and Agronomy, Technische Universität München, Alte Akademie 12, Freising, 85354, Germany; 2Department of Ecology, Czech University of Life Sciences, Kamýcka 1176, Prague, 16521, Czech Republic
The study aimed to clarify the influence of soil texture on roots and nodules of M. sativa and T. pratense in field experiment of organic farming. The soil texture had no effects on the nodules, but it is still not clear if it influenced the root traits variability.

P060

Root distribution and interactions in jujube tree/wheat agroforestry system
Zhang, W.; Li, L.; Wang, B.J.; Paniguli, A.
1College of Resources and Environmental Sciences, China Agricultural University, Peking(Beijing), China; 2College of Agriculture, Shihezi University, Shihezi, 832003, China
In a field study of 2 or 4 jujube tree were intercropped with wheat, we found that both root length densities of jujube tree and wheat were changed compared to corresponding sole cropping, which can partly explain the observed interspecific interactions above-ground.

P062

iRH: a comprehensive root hair information database
Kwasniewski, M.; Nowakowska, U.; Szumera, J.; Chwialkowska, K.; Szarejko, I.
Department of Genetics, University of Silesia, Jagiellonska 28, Katowice, 40-032, Poland
To date, more than 100 genes involved in root hair development have been identified and functionally characterized in plants. Kwasniewski et al. present an unique, comprehensive database, iRH, that integrates a large volume of data related to root hair genomics.

P067

Decreasing Cytosolic Triosephosphate Isomerase Expression Alters Carbon Metabolism in Transgenic Potato Roots
1IRBV, Université de Montréal, 4101 rue Sherbrooke est, Montréal, H1X 2B2, Canada; 2Instituto de la Grasa, CSIC, Av. Padre García Tejero, 4, Seville, 41012, Spain; 3Department of Biology, Lakehead University, 955 Oliver Road, Thunder Bay, P7B 5E1, Canada
Triosephosphate isomerase is involved in plastidial and cytosolic glycolysis. Dorion et al. used a genetic approach to evaluate the function of the cytosolic isomerase in transgenic roots. They show that a large decrease of this enzyme leads to alterations in carbon fluxes and metabolic pools.

P068
**Key root traits and useful genes on rainfed lowland rice breeding for water stress avoidance**


1Graduate School of Bioagricultural Sciences, Nagoya University, Japan; 2ICCAE, Nagoya University, Japan; 3Philippine Rice Research Institute, Philippines

In order to avoid water stress under rainfed lowland conditions, we found that maintaining and increasing the total root length are very important. We are now trying to understand genetic mechanisms regulating root development to improve root system architecture for rice breeding.

**P069**

**Enhancing resource Uptake from Roots under stress in cereal crops: the EURoot Project**


1Centre de coopération internationale en recherche agronomique pour le développement, Montpellier, France; 2Radboud Universiteit Nijmegen, Nijmegen, Netherlands; 3University of Lancaster, Lancaster, United Kingdom; 4Forschungszentrum Jülich, Jülich, Germany; 5University of Aberdeen, Aberdeen, United Kingdom; 6Eidgenössische Technische Hochschule Zürich, Zürich, Switzerland; 7Università di Bologna, Bologna, Italy; 8Univeristet Śląski w Katowicach, Katowice, Poland; 9Centre de Recherche en Agrigenomique, Barcelona, Spain; 10Université Catholique de Louvain, Louvain la Neuve, Belgium; 11Institut national de la recherche agronomique, Montpellier, France; 12Rheinische Friedrich-Wilhelms-Universität Bonn, Bonn, Germany; 13University of Nottingham, Nottingham, United Kingdom; 14Società Produttori Sementi, Bologna, Italy; 15PreSens, Regensburg, Germany; 16Delley Samen und Pflanzen AG, Delley, Switzerland; 17Institut national de la recherche agronomique, Avignon, France; 18Japanese International Research Centre for Agricultural Sciences, Tsukuba, Japan; 19Australian Centre for Plant Functional Genomics, Adelaide, Australia; 20Pennsylvania State University, University Park, United States

We describe the structure of a new EU FP7 funded consortium EURoot integrating physiology, genetics and soil and microbial sciences aiming at providing models, markers, signatures and tools for breeding cereal crops with an higher capacity to capture soil resources through their root system.

**P070**

**Modulating root system architecture in crops**

Somaiah, R.

Monsanto, 800 N Lindbergh, St Louis, 63141, United States

Modulating RSA is expected to benefit plant growth and yield under standard agronomic and stressful environments. The screening capabilities for assessing RSA and transgene testing strategies to improve root architecture and function is outlined in the poster.

**P072**

**Differences in modern North European winter wheat cultivars in deep root growth**

Ytting, N.K.; Thorup-Kristensen, K.; Andersen, S.B.

1Department of Agriculture and Ecology, University of Copenhagen, Højbakkegård Allé 13, Taastrup, 2630, Denmark; 2Department of Agriculture and Ecology, University of Copenhagen, Thorvaldsensvej 40, Frederiksberg, 1871, Denmark

Deep rooting is an important factor reducing nitrate leaching potential. Measurements of root penetration rate in transparent soil columns was used as a fast screening method to find significant cultivar differences in modern winter wheat cultivars.

**P073**

**Functional analysis of PvSPX1 regulating bean roots in response to phosphate starvation**

Liao, H.; Yao, Z.; Liang, C.; Tian, J.

Root Biology Center, South China Agricultural University, Wushan, Guangzhou, 510642, China

PvSPX1 played a vital role for bean roots responding to P deficiency through modifying root growth and up-regulating expression levels of downstream genes.

**P074**
**Root specific expression of OsNAC10 improves drought tolerance and grain yield in rice**

Jeong, J.S.; Jang, G.; Kim, Y.S.; Jung, H.; Kim, J.K.

School of Biotechnology and Environmental Engineering, Myongji University, Nam-Dong, Chuin-Gu, Yongin, 449-728, South Korea

Drought stress is one of the major constraints to crop production. This study shows that OsNAC10 is involved in drought resistance mechanisms of rice and controlling of root radial growth can be one of the potential tools for improving drought resistance and grain yield in rice.

**P075**

**Comparison of root systems of durum wheat of different origin and genetic resources**


Department of Crop Science, University of Natural Resources and Life Sciences, Gregor Mendel Straße 33, Vienna, Austria

Diversity of root traits is of potential use in breeding for efficient water uptake. Although genetic resources show most diverse root morphologies, also within modern durum germplasm high diversity exists. Capacitance measurement can be used as a pre-screening tool for root system diversity.

**P076**

**Varying substrate compaction in split-root rhizotron systems affects barley root growth and shoot performance**

Pfeifer, J.; Nagel, K. A.; Faget, M.; Blossfeld, S.; Walter, A.

1Plant Sciences (IBG-2), Forschungszentrum Jülich GmbH, Wilhelm-Johnen-Straße, Jülich, Germany; 2Institute of Agricultural Sciences, ETH Zürich, Universitätsstrasse 2, Zürich, Switzerland

The impact of heterogeneous soil compaction on root system architecture and root growth dynamics is scarcely investigated. We analyzed effects of substrate compaction on barley root and shoot growth by an automatic rhizotron screening device facilitating such studies for research and phenotyping.

**P077**

**Identification of loci/genes regulating root morphology of wheat**

Tong, Y.; He, X.; Zhao, X.; Ma, W.; Li, B.; Li, Z.

Institute of Genetics and Development Biology, Chinese Academy of Sciences, No.1 West Beichen Road, Chaoyang District, Beijing, 100101, China, Beijing, China

We constructed a pair of NILs with significant differences in root morphology for qTaLRO-B1, a major QTL for maximum root length and primary root length. Further proteomic study on the pair of NILs showed that TaTRIP1 was involved in regulating root morphology of wheat by BR signaling pathway.

**P078**

**A new high-throughput technique to screen root depth in different rice varieties associated with mapping (qtl)**

Alshugeairy, Z.; Standing, D.; Price, A.

Plant and Soil Science, University of Aberdeen, Cruickshank Building, Aberdeen, AB24 3UU, United Kingdom

**P079**

**Genetic diversity of Oxalate oxidase activity in water-stressed roots of maize**

Thompson, H.; Voothuluru, P.; Flint-Garcia, S.; Sharp, R.E.

1Plant Sciences, University of Missouri-Columbia, 1-31 Agriculture Building, Columbia, 65211, United States; 2Division of Plant Sciences, University of Missouri, United States; 3Division of Plant Sciences, USDA-ARS Plant genetics Research Unit, Columbia, 65211, United States; 4Division of Plant Sciences, University of Missouri, 1-31 Agriculture Building, Columbia, 65211, United States

The relationship of oxalate oxidase activity (produces hydrogen peroxide) to root elongation under water stress was evaluated among diverse maize lines. Temperate lines generally showed increased activity in the apical elongation zone, whereas subtropical lines exhibited diverse patterns of activity.

**P080**
**Poster Session 1**

**Tuesday, June 26, 2012**

**13:45-15:00**

**1.F01**

**Characterization and transcriptional expression of the β-expansin gene family in soybean**

Li, X.; Luo, H.; Liao, H.; Zhao, J.

State Key Laboratory for Conservation and Utilization of Subtropical Agro-bioresources, Root Biology. South China Agricultural University, Wusan Street, Tianhe District, Guangzhou City, 510642, China

Expansin proteins play various biological roles during plant growth and development. Real-time PCR results demonstrate that nine soybean β-expansin genes act as different roles in organ development and in adaptation to abiotic stresses. Some GmEXPBs involve in soybean symbiosis with rhizobia or AM fungi.

**P084**

**Mapping and functional analysis of REDUCED ROOT LENGTH2 gene, RRL2, in rice**

Shelley, I.J.; Ozaki, H.; Kitano, H.; Inukai, Y.

1Graduate School of Bioagricultural Sciences, Nagoya University, Japan; 2Biotecnologia and Bioscience Center, Nagoya University, Japan

We screened a rice recessive mutant, rrl2, characterized by a reduced root length and employed a map-based cloning approach to isolate the causative gene, RRL2. We succeeded in finding the candidate gene on the chromosome 1 around 95 cM and now trying to understand the function of it.

**P085**

**Roots for low nutrient availability – genotypic variation in spring wheat (Triticum spp. L.)**

Lundell, J.

Dept. of Agriculture and Ecology, University of Copenhagen, Inst. of Crop Science, Højbakkegård allé 13, Taastrup, Dk-2630, Denmark

Genotypic variation was found in root density and distribution in the top soil volume between twelve spring wheat cultivars. First order lateral roots differed significantly in time of initiation, site of appearance and density, where particular genotypes presented early and intensive abundance.

**P086**

**Soybean stem-termination isolines differ in rooting characteristics**

Manavalan, L.P.; Hames, K.A.; Fritschi, F.B.

Division of Plant Sciences, University of Missouri, 1-31 Agriculture Building, Columbia, 65211, United States

Soybean isolines with distinct shoot architecture may also differ in root characteristics. Seasonal soil moisture depletion pattern and end-of-season root sampling indicate these lines possess divergent root characteristics.

**P087**

**Detection of chromosome fragments associated with growth angle of seminal roots in wheat (Triticum aestivum L.)**

Mori, M.; Abe, F.; Haque, M.E.; Kawaguchi, K.; Oyanagi, A.

NARO Institute of Crop Science, 2-1-18 Kannondai, Tsukuba, 305-8518, Japan

The growth angle of seminal roots is one of the important traits in wheat. There were clear differences in the growth angle of seminal roots between CS and CS ditelosomic 6AS and 6BS lines. These lines showed significantly larger value of root angle from the horizontal than those of CS.

**P088**
**Poster Session 1**

**TTL genes in lateral root growth and development**
Ales, S.1; Sefrnova, Y.; Delgado, A.H.; Cvrckova, F.; Fischer, L.; Vielle Calzada, I.P.; Dubrovsky, J.G.

1Experimental Plant Biology, Charles University in Prague, Vinicna 5, Prague, Czech Republic; 2Cinvestav - Guanajuato, Mexico; 3Instituto de Biotecnología, UNAM, Mexico

Novel regulatory elements from the family of Tetratricopeptide-repeat Thioredoxin-like proteins were identified to take part in lateral root development. Their expression pattern and mutant phenotype were recorded and bioinformatics analysis of phylogeny and distribution of genes was tested.

**Phenotyping of root system size in field by its electrical capacitance and relevant genes**
Chloupek, O.; Streda, T.

Crop Science, Mendel University, Zemedelska 1, Brno, 61300, Czech Republic

Evaluation of root system size by its electrical capacitance gives relative values comparable for the same species, substrate and time. Responsible genes were mapped associated with agronomic traits. Selection for greater capacitance in alfalfa and clover was effective.

**Phenotyping root architectural traits of a tropical japonica rice panel in view of association mapping**
Audebert, A.1; Roques, S.1; Dardou, A.1; Rouan, L.2; Gozé, E.2; Frouin, J.1; Ahmadi, N.1; Ghneim, T.1; Courtois, B.1

1Cirad, UMR AGAP, Montpellier, 34398, France; 2Cirad, UMR SCA, Montpellier, 34398, France; 3ICESI university, Cali, Colombia

Audebert et al. phenotyped an association panel of 200 tropical japonica rice lines in a semi-hydroponic system composed of Plexiglas plates filled with glass beads. Varieties from Brazil, Indonesia and Taiwan showed the deepest roots. No link was noticed between root depth and cone angle.

**New pathways regulating Medicago truncatula root architecture**
Laffont, C.1; Plet, J.1; Cosson, V.1; Ratet, P.2; Frugier, F.2

1CNRS, bat 23 avenue de la terrasse, Gif/Yvette, France; 2CNRS, Montpellier, 34398, France; 3ICESI university, Cali, Colombia

Legume root system consists in lateral roots and symbiotic nitrogen fixing nodules. Laffont et al. identified mutants affected in these lateral organogenesis processes, either by targeting the cytokinin signalling pathway or by characterizing “compact root architecture” mutants.

**Future developments for non-destructive 3D plant and root imaging**

1R&D, LemnaTec, 18 Schumanstr, Wuerseilen, 5246, Germany; 2LemnaTec, 18 Schumanstr, Wuerseilen, 5246, Germany; 3Beta Klinik, Joseph-Schumpeter-Allee 15, Bonn, 53227 Germany; 4University of Bergen, Jonas Lies vei 9L, Bergen, 5009 Norway; 5HF TU Braunschweig, Schleinitzstr. 22, Braunschweig, 38106, Germany

The goal of this joint study is to explore whether Nuclear Magnetic Resonance Imaging (NMRI) or (Sub) Terahertz Imaging (THz) might be used for obtaining non-invasive and valuable information about plant roots in soil or substrate.

**Most important genetic position controlling potato root mass is located at Chromosome 5**

1Research Faculty of Agriculture, Hokkaido University, NWW9 Kitaku, Sapporo, 060-8589, Japan; 2Wageningen University and Research Centre, Wageningen, Netherlands

QTLs with high LOD scores (about 20) for root length and dry weight were detected at one distinct region of Chromosome 5 in CxE diploid potato population grown in pots for two years. About two thirds of genotypic variation in both root traits related to plant maturity measured in the field.

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QTLs with high LOD scores (about 20) for root length and dry weight were detected at one distinct region of Chromosome 5 in CxE diploid potato population grown in pots for two years. About two thirds of genotypic variation in both root traits related to plant maturity measured in the field.

**QTL genes in lateral root growth and development**
Ales, S.1; Sefrnova, Y.; Delgado, A.H.; Cvrckova, F.; Fischer, L.; Vielle Calzada, I.P.; Dubrovsky, J.G.

1Experimental Plant Biology, Charles University in Prague, Vinicna 5, Prague, Czech Republic; 2Cinvestav - Guanajuato, Mexico; 3Instituto de Biotecnología, UNAM, Mexico

Novel regulatory elements from the family of Tetratricopeptide-repeat Thioredoxin-like proteins were identified to take part in lateral root development. Their expression pattern and mutant phenotype were recorded and bioinformatics analysis of phylogeny and distribution of genes was tested.

**QTL genes in lateral root growth and development**
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Novel regulatory elements from the family of Tetratricopeptide-repeat Thioredoxin-like proteins were identified to take part in lateral root development. Their expression pattern and mutant phenotype were recorded and bioinformatics analysis of phylogeny and distribution of genes was tested.
**The root architecture of Brachypodium distachyon and its application to wheat genetic improvement**

Chochois, V.; Vogel, I.; Wilson, I.; Helliwell, C.; Bragg, J.; Watt, M.

1Plant Industry, CSIRO, GPO Box 1600, Canberra, 2601, Australia; 2ARS WRRC, USDA, Albany, 94710, United States

Brachypodium distachyon is a temperate grass phylogenetically close to wheat and their root development is very similar. We are using it as a model to speed up the identification of genes affecting wheat root vigour and architecture, thanks to its small size and to the numerous tools available.

**Arabidopsis homolog of Trithorax1 is required for cell patterning and morphogenesis in Arabidopsis root development**


1Instituto de Biotecnología, Universidad Nacional Autónoma de México, Av. Universidad 2001, Col. Chamilpa, Cuernavaca, 62210, Mexico; 2CINVESTAV IPN, Unidad Irapuato, Mexico

Root system is a result of new apical meristem formation. Using a loss-of-function mutant in Arabidopsis homolog of Trithorax1 (ATX1) Dubrovsky et al. demonstrate that ATX1 gene is required for cell patterning and morphogenesis both in primary and lateral root development in Arabidopsis thaliana.

**Mapping QTLs for root system architecture of maize under field conditions**

Chen, F.J.; Cai, H.G.; Mi, G.H.; Zhang, F.S.; Maurer, H.P.; Liu, W.X.; Reif, J.C.; Yuan, L.X.

1Dept. Plant Nutrition, China Agricultural University, No.2 Yuan Ming Yuan Xi Lu, Beijing, 100193, China; 2State Plant Breeding Institute, University of Hohenheim, Stuttgart, 70599, Germany

The development of root system architecture (RSA) is central for maize productivity. Using advanced-backcross QTL analysis, Yuan et al. revealed the establishment of roots at early stage associated with grain yield formation, and identified several QTLs clusters for RSA under field conditions.

**Potato roots; phenotyping under glass and in the field. Root relationships with yield predict the effect of drought**

Wishart, J.; George, T.S.; Brown, L.K.; Ramsay, G.; White, P.; Gregory, P.

1Biology, University of St Andrews, Bute Building, St Andrews, KY16 9TS, United Kingdom; 2Plant Soil Ecology, James Hutton Institute, Invergowrie, Dundee, DD2 5DA, United Kingdom; 3Genetics, James Hutton Institute, Invergowrie, Dundee, DD2 5DA, United Kingdom; 4East Malling Research, New Road, East Malling, ME19 6BJ, United Kingdom

Variation in rooting characteristics of potato genotypes was identified after two weeks growth under glass and many were highly correlated with the same measures from the field. Final yield was positively associated with rooting characteristics which also gave an advantage when droughted.

**Characterization of auxin-related genes in barley involved in root development**

Orman, B.; Bennett, M.; Waugh, R.; Dray, X.

1Crop physiology and Plant breeding, Earth and Life Institute, Agronomy, Universite catholique de Louvain, Croix du Sud 2, L70511, Louvain-la-Neuve, 1348, Belgium; 2Plant Sciences Division, School of Biosciences, University of Nottingham, Sutton Bonington Campus, Loughborough, LE12 9RD, United Kingdom; 3Department of Genetics, The James Hutton Institute, Invergowrie, Dundee, DD2 5DA, United Kingdom

Auxin influx carriers in Arabidopsis mediate the formation of local auxin gradients which are crucial for many aspects of root development. How these regulatory processes translate in crops remains widely unexplored. Two carriers have been identified in barley and their possible role is discussed.
**Poster Session 1**

**Room 1.F01**

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**A positive feedback loop between light and strigolactones in tomato roots**
Kapulnik, Y.; Cohen, M.; Mayzlish-Gati, E.; Wininger, S.; Steinberger, Y.; Ben Dor, B.; Koltaï, H.
1Agronomy and Natural Resources, ARD, Volcani Center, POB 6, Bet Dagan, 50250, Israel; 2The Mina & Everard Goodman Faculty of Life Sciences, Bar-Ilan University, Ramat-Gan, Israel

Strigolactones (SLs) are a new group of plant hormones. Using physiological, biochemical and genomic approaches, Cohen et al., demonstrated that SLs and light perception are associated via a positive feedback loop in the plant; this may explain their similar effect on plant development.

**P101**

**Identification of QTL for root architectural traits under low and optimal phosphorus availability in Brassica napus**
1National Key Lab of Crop Genetic Improvement, Huazhong Agricultural University, No. 1 Shizishan Street, Hongshan District, Wuhan, 430070, China; 2Division of Plant and Crop Science, University of Nottingham, Sutton Bonington Campus, Loughborough, LE12 5RD, United Kingdom

Root architecture traits play an important role in the plant adaptations to the low phosphorus availability in soil. Shi et al. results demonstrate that about 30% QTL detected for root traits of Brassica napus with agar culture were co-located with QTL for seed yield and seed yield components at LP.

**P102**

**Genetic and molecular characterization of TaSTOP1 for Al toxicity in bread wheat (Triticum aestivum L.)**
Garcia-Oliveira, A.L.; Benito, C.J.; Prieto, P.; Menezes, R.; Rodrigues-Pousada, C.; Guedes-Pinto, H.; Martins-Lopes, P.
1Centro de Genomica e Biotecnologia, Portugal; 2Universidade Complutense de Madrid, Spain; 3Instituto de Agricultura Sostenible /CSIC, Spain; 4Instituto de Tecnologia Quimica e Biologica, Portugal

Here, we identified a novel gene, TaSTOP1 having transcription factor activity and localized on chromosomes 3A, 3B and 3D in bread wheat. Transcript expression study suggests the role of TaSTOP1 under Al tolerance at post-transcriptional level in wheat.

**P103**

**Root response to drought stress in Arabidopsis thaliana**
El Soda, M.; Koornneef, M.; Aarts, M.G.M.
Plant Genetics, Wageningen UR, PO Box 309, Wageningen, 6700 AH, Netherlands

We identified major qtls controlling root response to drought stress. These qtls will be further confirmed using HIFs.

**P104**

**Diversity in leaf and root morphological characteristics of trembling Aspen (Populus tremula)**
Hajek, P.; Hertel, D.; Leuschner, C.
Albrecht-von-Haller Institute for Plant Sciences, Department of Ecology and Ecosystem Research, University of Goettingen, Untere Karspuele 2, 37073 Goettingen, Germany

Intra- and interspecific variation of leaf and root morphological characteristics among eight aspen demes point to genetically driven adaption strategies with no significant effect of deme on the interrelations of above- and belowground traits.

**P105**

**Spring wheat genotype selection based on root hair and rhizosphere traits**
Wang, Y.; Magid, J.; Jensen, L.S.; Thorup-Kristensen, K.
Department of Agriculture and Ecology, Faculty of Life Sciences, University of Copenhagen, Thorvaldsensvej 40, Frederiksberg C, DK-1871, Denmark

The variations in root and root hair traits among wheat cultivars under conditions of low nutrient availability are investigated to identify superior cultivars and critical root traits for higher nutrient use efficiency, which may be grown in organic production or used in breeding for new cultivars.

**P106**
Which processes drive fine root elongation in a natural forest ecosystem?
Stokes, A.1; Mao, Z.1; Bonis, M.L.1; Rey, H.2; Saint-André, L.2; Stokes, A.1; Jourdan, C.4
1INRA, AMP, PS2 TA/AS1, 2, Bld de la Lironde, Montpellier cedex 5, 34398, France; 2CIRAD, AMP, PS2 TA/AS1, 2, Bld de la Lironde, Montpellier cedex 5, 34398, France; 3INRA, UR BEF – Biogéochimie des Écosystèmes Forestiers, Champenoux, 54280, France; 4CIRAD, UMR Eco&Sols – Écologie Fonctionnelle & Biogéochimie des Sols & Agroécosystèmes, 34060, France
Fine root growth in subalpine forest ecosystems is governed by soil temperature. Root growth can occur as long as soil temperatures are >0°C, even when monthly mean air temperatures are sub-zero.

P109

Root phytotoxicity by pre-emergence herbicides in high erucic Brassica seedlings
Zanetti, F.1; Vamerali, T.2; Mosca, G.1; Rampin, E.3
1DAFNAE, University of Padova, Agripolis, vial dell’Università 16, Legnaro, 35020, Italy; 2Dept. of Environmental Sciences, University of Parma, Viale G.P. Usberti 1/A, Parma, 43100, Italy; 3DAFNAE, University of Padova, Agripolis, Viale dell’Università 16, Legnaro, 35020, Italy
The extension of pre-emergence herbicides, used for B. napus, to minor high-erucic species should carefully consider root phytotoxicity at early stages, that may compromise establishment. The overcoming of phytotoxicity was more rapid in field than in greenhouse due to faster herbicide degradation.

P110

Miraculous plant derived smoke induce early and vigorous rooting in Ipomoea aquatic compared to IBA, IAA and GA
Plant Sciences, KUST, Kohat University of Science and Technology (KUST), Kohat, 26000, Pakistan
These results showed that plant derived smoke solution induced early and vigorous rooting in Ipomoea aquatic, therefore, it could be used for quicker and healthier rooting, which could subsequently result in a healthy plant. Moreover, it is easy and economical to produce plant smoke which is environmental friendly, could be used as bio-enhance and bio-fertilizer.

P111

Use of GFP to determine the influence of competition on root dynamics
Rewald, B.1; Rachmilevitch, S.2; Ephrath, J.E.2
1French Associates Institute for Agriculture and Biotechnology of Drylands, Ben-Gurion University of the Negev, Campus Sede Boqer, Mithreshet Ben Gurion, Israel; 2French Associates Institute for Agriculture and Biotechnology of Drylands, Ben-Gurion University of the Negev, Israel
GFP expressing and non-GFP plants can be easily distinguished by the strong, green fluorescence of transgenic roots as compared with minor autofluorescence. The stable expression of GFP in crop plants allows for advanced studies on spatial and temporal rooting pattern in plant mixtures.

P113

Quantitative relationship between microbial respiration and resource quality of dead fine root in a broad-leaved forest
Kawamura, A.; Makita, N.; Osawa, A.
Kyoto University, Graduate School of Agriculture, Kyoto University, Kyoto, Japan
Microbial decomposition respiration of tree fine root was determined by resource quality beyond the two diameter classes and species. The quantitative relationship between microbial respiration and resource quality of dead fine root enables us to explain mechanisms in the fine root decomposition.

P114

Decomposition of fine-root and aboveground litters – quantification of soil microbial activity parameters
Liiva, H.; Orupõld, K.; Purgas, M.; Püttepp, Õ.
Estonian University of Life Sciences, Kreutzwaldi 5, Tartu, Estonia
Decomposition of roots and aboveground litter in forest soils can be inhibited by environmental stress. Liiva et al. demonstrated in a microcosm experiment with decomposing fine-root and aboveground litters that microbial respiration but not the soil enzymatic activities, were inhibited by the presence of Cu and Cd.

P115
Breeding plants with deep roots for carbon, water and nutrient sequestration: what may be achievable?
Kell, D.
BBSRC & School of Chemistry and MIB, The University of Manchester, United Kingdom
An extra 1m depth of roots deployed over existing croplands and grasslands (ca 2300 Mha each) can have a very substantial impact in mitigating CO₂ increases (see also http://dbkgroup.org/carbonsequestration/rootsystem.html); we need to breed plants that can produce them.
P116

Fine root carbon age variation in boreal conifer forests determined by radiocarbon method
Sah, S.P.; Bryant, C.; Leppälammi-Kujansuu, J.; Lõhmus, K.; Ostonen, I.; Helmisaari, H.S.
1Department of Forest Sciences, University of Helsinki, PO Box 27 (Latakantanonkaari 7), Helsinki, FI-00014, Finland; 2NERC Radiocarbon Facility (Environment), Scottish Enterprise Technology Park, Rankine Avenue, East Kilbride, G75 0QF, United Kingdom; 3University of Tartu, Institute of Geography, Vanemuise 46, Tartu, 51014, Estonia
On the contrary to our expectation, we observed that up to 2-years old live larger fine roots of ingrowth cores of one of our sites showed similar C ages (7-12 years) as in the soil core fine roots and this can only be explained by the fact that new live roots grew from old carbon reserves.
P117

Below-ground parts of understorey vegetation in the carbon cycling of boreal coniferous forests
Salemaa, M.; Helmisaari, H-S.; Hilli, S.
1Vantaa Unit, Finnish Forest Research Institute, PO. Box 18, Vantaa, FI-01301, Finland; 2Faculty of Agriculture and Forestry, University of Helsinki, PO. Box 27 FI-00014 University of Helsinki, Finland; 3Rovaniemi Unit, Finnish Forest Research Institute, PO. Box 16, Rovaniemi, FI-96301, Finland
The living roots and rhizomes may have a significant effect to the change of C pool in the organic layer of boreal forests.
P118

Contribution of Mycorrhizal Hyphae to Carbon Fluxes in Temperate Forests
Andreasson, F.; Dannoura, M.; Kominami, Y.; Hirano, Y.; Makita, N.; Ataka, M.
1Laboratory of Forest Utilization, Graduate School of Agriculture, Kyoto University, Kitashirakawa Oiwake-cho, Sakyo-ku, Kyoto, 606-8502, Japan; 2Forestry and Forest Products Research Institute, Japan; 3School of Bioagricultural Science, Nagoya University, Japan; 4Laboratory of Forest Hydrology, Graduate School of Agriculture, Kyoto University, Japan
External mycorrhizal hyphae contribute to the complex carbon flux from temperate forest soils. Activity of mycorrhizal hyphae shows seasonal variations.
P119

Use of X-ray computed tomography to assess root decomposition in situ
Haling, R.; Tighe, M.; Flavel, R.; Young, I.
School of Environmental and Rural Science, University of New England, Armidale, 2351, Australia
Understanding the dynamics of root turnover and decomposition is crucial for quantifying the contribution of roots to soil carbon and nutrient cycling. This paper investigates the potential to use X-ray computed tomography to study root turnover and decomposition directly in soil.
P120

Assessment of the ability of barley for phytoremediation of soils contaminated with Zn, Cd or Cr
Gonzalez, A.; Chumillas, V.; Lobo, M.C.
Agroenvironmental Research, IMIDRA, Finca, Alcalá de Henares, 28800, Spain
The tolerance of barley plants exposed to increasing concentrations of Zn,Cd and Cr have been evaluated. The results showed significant tolerance to zinc and cadmium, but toxic effects were observed when plants were treated with Cr. The highest percentage of metal was found in the roots in all cases.
P122
**Poster Session 2**

**Use of plants with allelopathy potential as a bio-barrier against bio-intrusion on covers with capillary barrier effects**

Bussière, B.; Bergeron, Y.; Tremblay, F.; Thiffault, N.; Joanisse, G.; Smirnova, E.

1UQAT (Université du Québec en Abitibi-Témiscamingue), Canada; 2MRNF (Ministère des Ressources naturelles et de la Faune du Québec), Canada; 3CERFO (Centre d’enseignement et de recherche en foresterie de Sainte-Foy), Canada; 4UQAT, 445, boul. de l’Université, Rouyn-Noranda, J9X 5E4, Canada

Bluejoint reedgrass is the most promising bio-barrier species for the CCBE (cover with capillary barrier effects) compared to sheep laurel and Labrador tea. Mainly through root system development bluejoint reedgrass has rapid and strong inhibitory effects on undesirable trees. Favorable planting substrate will amplify bio-barrier species efficiency on the CCBE.

P123

**Plants adapted to the arctic tundra conditions: structural features of roots**

Tarshis, L.

ecology department, Pedagogical University, Belorechenskaya street, number 9/4, 27 Ekaterinburg, 620012, Russia

Root structure features of all the studied of the flowering herbaceous perennial plants and small shrubs show how the angiosperm plants are adapting to the harsh tundra conditions in a vast variety of ways.

P126

**The guttation rate as a criterion of physiological status of plants**

Polonskiy, V.; Polonskaya, D.

1Krasnoyarsk State Agrarian University, Milla str., 90, Krasnoyarsk, 660049, Russian Federation; 2Krasnoyarsk State Agrarian University, Russian Federation

It was shown that the root activity which was measured using value of GR of seedlings is the parameter of physiological status of plants and can be used for nondestructive evaluation of cultivars for resistance to different stress-factors and monitoring of environment quality.

P127

**Fine-root patterns along a drought gradient in Spruce forests (Picea crassifolia) of the Qilian Mountains**

Wagner, B.; Dulamsuren, C.; Liang, E.; Leuschner, C.; Hauck, M.

1Plant Ecology and Ecosystem Research, University of Goettingen, Untere Karstrupé 2, Goettingen, 37073; 2Plant Ecology and Ecosystem Research, University of Goettingen, Untere Karstrupé 2, Goettingen, 37073, Germany; 3Institute of Tibetan Plateau Research, Chinese Academy of Sciences, PO.Box 2871, Beijing, 100085, China

First observations show differences in the ratio between biomass and necromass along the elevation gradient, but need to be further quantified.

P128

**Comparison of Brassica napus and Alyssum serpyllifolium regarding platinum group element-uptake, determined by ICP-OES**

Herincs, E.; Limbeck, A.; Puschenreiter, M.; Wenzel, W.W.

1Department of Forest and Soil Sciences, Institute of Soil Science, University of Natural Resources and Life Sciences, Konrad Lorenz Straße 24, 3430 Tulln an der Donau, Austria; 2Institute of Chemical Technologies and Analytics, Division of Instrumental Analytical Chemistry, Vienna University of Technology, Getreidemarkt 9, 1060 Vienna, Austria

Within our studies the variable uptake of platinum group elements (PGEs) in both Brassica napus and Alyssum serpyllifolium, cultivated in nutrient solution at two pH levels and various PGE concentrations, was investigated using inductively coupled plasma optical emission spectrometry (ICP-OES).

P129

**Interaction of the trace elements with the iron mineral in the presence of organic acids produced by plant roots**

Perelomov, L.V.; Violante, A.

1Tula State University, Lenin Avenue, 92, Tula, 3000600, Russia; 2University of Naples, Italy

The sorption of Cu and Pb added alone or in mixture in the absence or presence of low molecular mass aliphatic acids (LMMAAs) produced by plant roots (oxalic, citric or glutamic) onto a goethite at different pH values was studied.

P130
Silicon and cadmium interaction in two Brassica species
Department of Glycobiotechnology, Institute of Chemistry, Slovak Academy of Sciences, Dúbravská cesta 9, Bratislava, 84538, Slovakia

Comparing the effect of silicon and cadmium on two Brassica species, Zelko et al. demonstrated positive effect of Si on growth and Cd translocation from root to shoot in Cd treated plants. Based on further results B. napus seems to be more suitable for Cd phytoextraction than B. juncea.

P131

Root responses after severe metal contamination: learning for phytoremediation purposes
Bandiera, M.¹; Lucchini, P.; Mosca, G.²; Vamerali, T.²
¹Department of Agronomy, Food, Natural resources, Animals and Environment, University of Padova, Viale dell'Università 16, Legnaro - Padova, 35020, Italy; ²Department of Environmental Sciences, University of Parma, Viale G.P. Usberti II/A, Parma, 43100, Italy

The root system of plant species is more sensitive to soil metal pollution than shoots, and this may reduce the phytoremediation efficiency. Standardised root growth (contaminated/control) may be a suitable index of species selection for phytoremediation purposes.

P132
Hydraulic redistribution via adventitious roots of Juniperus sabina L., an evergreen shrub growing in semi-arid region
Yoshikawa, K.1; Yang, L.2; Miki, N.1; Matsuo, N.3
1Okayama University, Post Graduate School of Environmental Science, Tsushima Naka 1-1-1, Okayama, 700-8530, Japan; 2Okayama University, Post Graduate School of Environmental Science, Japan; 3Mie University, Japan
Juniperus sabina grows in semi-arid region by spreading decumbent stems with adventitious roots. Dye-solution-feeding experiment and sap-flow velocity measurement were conducted to determine the role of adventitious roots. Results suggested the presence of hydraulic redistribution.

New clues from proton flux of root border cells exposed to aluminum and cadmium toxicity under low pH
Yu, M.; Li, X.; Wang, H.; Xiao, H.; Feng, Y.; Liu, J.; He, L.
Department of Horticulture, Foshan university, 18 Jiangwanyilu, Foshan, Guangdong, China, Foshan, 528000, China
Using Non-invasive Micro-test Technology, Yu et al. reported that Al toxicity promoted H+ efflux from root border cells while Cd toxicity promoted H+ influx. H+ influx in the tip and tail of root border cells while H+ efflux in the body suggested the polar growth of root border cells.

How the hydraulic parametrisation of roots affects overall plant-soil interactions
Bechmann, M.1; Schneider, C.L.2; Hildebrandt, A.3
1Friedrich-Schiller-University Jena, Hans Knöll Str 10, Jena, 07745, Germany; 2Helmholtz Centre for Environmental Research ( UFZ), Germany; 3Friedrich-Schiller-University Jena, Germany
Root water uptake profiles (RWUP) are governed by root properties as well as by overall root system's topology. Root length density profiles (RLDP) are unsuitable predictors for RWUP at small scales. Plant individuals that are very similar in terms of RLDP may show significantly different RWUP.
The effect of contrasting fertilisation regimes on root gene expression and associated rhizosphere community composition
Tétard-Jones, C.¹; Edwards, M.²; Gatehouse, A.M.R.²; Handley, J.A.²; Leifert, C.¹; Cooper, J.¹
¹Agriculture, Food and Rural Development, Newcastle University, United Kingdom; ²School of Biology, Newcastle University, United Kingdom

P208

Cluster-root formation and carboxylate release vary among Lupinus species under different phosphorus supply
Wang, X.; Pearse, S.J.; Lambers, H.
School of Plant Biology, 35 Stirling Highway, Perth, 6009 Australia

Investment of resources in cluster roots was regulated by P supply, irrespective of plant growth rate, suggesting a complex relationship.

P209

Interaction of root architectural and anatomical phenes in maize
Nord, E.A.; York, L.M.; Postma, J.A.; Lynch, J.P.
Horticulture, Penn State, University Park, 16851, United States

The optimal number of crown roots in maize differed between nitrogen and phosphorus stressed plants. The extent to which cortical aerenchyma increased root length and biomass depended on crown root number. Nord et al. demonstrate interaction between these root phenes.

P210

The physiological utility of root cortical aerenchyma for efficient nitrogen acquisition in maize (Zea mays)
Saengwilai, P.¹; Brown, K.M.²; Lynch, J.P.²
¹Intercollege Program in Plant Biology, Pennsylvania State University, University Park, 16802, United States; ²Horticulture, Pennsylvania State University, University Park, 16802, United States

Root cortical aerenchyma improves plant growth under nitrogen stress by decreasing root metabolic costs, enhancing soil exploration in the deep soil profile, thus allowing the plants to acquire nitrogen at greater depths.

P211

Apoplastic barriers in outer cortex of lateral roots
Tylová, E.; Husáková, E.; Soukup, A.
Department Experimental Plant Biology, Faculty of Science, Charles University in Prague, Vinièná 5, Prague 2, 12844, Czech Republic

Lateral roots mediate major communication with rhizosphere. The differentiation of their internal structure (including exodermis) in response to environmental conditions resembles main root axis, but is less pronounced. The state of differentiation correlates with functional properties of root.

P212

The effects of trinexapac-ethyl on cytosolic free Ca²⁺ in winter wheat root meristem
Luzin, O.G; Virych, P.A; Makoveychuk, T.I.; Mykhalskaya, L.N.; Schwartau, V.V.
The Institute of Plant Physiology and Genetics of the National Academy of Sciences of Ukraine, 31/17 Vasylkivska Str., Kyiv-22, UA, Kyiv, 03022, Ukraine

Cytosolic free Ca²⁺ were collected in vacuoles under trinexapac-ethyl (TE) influence. Using fluorescense dye Fluo-3 AM, we demonstrate that 10⁻⁶ M TE induced [Ca²⁺]cyt decrease by 52%, compared to the control variant. Observed changes may be related to a GA metabolism modification.

P213

Hydraulic lift maintains shallow root conductivity during drought
Prieto, I.¹; Ryel, R.I.²
¹Centre d’Ecologie Fonctionnelle et Evolutive, 1919, Route de Mende Cefex 5, Montpellier, 34293, France; ²Utah State University, United States

Water redistributed to roots maintains maximum root conductivities after a significant drought period, likely by modifying xylem development, either through growth of xylem vessels or more vessels/area. This may have implications for root and plant water transport.

P214
**Poster Session 2**

**The relationship between root cell wall properties and salt tolerance of soybean**

AN, P.1; Inoue, T.1; Zheng, M.Q.1; Eneji, A.E.2; Inanaga, S.3

1Arid Land Research Center, Tottori University, Hamaaska 1390, Tottori, 680-0001, Japan; 2Faculty of Agriculture, University of Calabar, PMB 1115, Nigeria; 3RIKEN Plant Science Center, Japan

Higher levels of pectin and uronic acid in root cell wall resulted to higher cation exchange capacity (CEC). The higher CEC may lower the pH of the apoplast and thus activate the transport processes in the membrane, which may overall enhance plant growth under saline conditions.

**Lignification process during xylogenesis of Populus trichocarpa roots**

Bagniewska-Zadworna, A.1; Stelmasik, A.1; Byczyk, J.2; Zadworny, M.3

1Department of General Botany, Institute of Experimental Biology, Faculty of Biology, A. Mickiewicz University, Umultowska 89, Poznañ, 61-614, Poland; 2Department of Virology and Bacteriology, Institute of Plant Protection, National Research Institute, Węgorzka 20, Poznañ, 60-318, Poland; 3Polish Academy of Sciences, Institute of Dendrology, Parkowa 5, Komik, 62-035, Poland

The daily development of tracheary elements in first order roots of P. trichocarpa was monitored to uncover all stages of early vessel formation. Throughout each root stage the expressions of CLS and CAD genes, which can be treated as markers of xylogenesis, were studied.

**Relationship between root and shoot morphological traits of seedlings in four strains of Erianthus arundinaceus**

Abe, J.1; Shiotsu, F.2; Ra, K.3; Hayashi, T.3; Gau, M.4; Uwatoko, N.4; Morita, S.3

1AE-Bio, The University of Tokyo, Yayoi, Bunkyo-ku, Tokyo, 113-8657, Japan; 2The College of Agriculture, Ibaraki University, Ami, Ibaraki, 300-0393, Japan; 3Institute for Sustainable Agro-ecosystem Services, The University of Tokyo, Nishitokyo, Tokyo, 188-0002, Japan; 4National Agricultural Research Center for Kyushu Okinawa Region, NARO, Koshi, Kumamoto, 861-1192, Japan

Erianthus arundinaceus is expected as a new biomass plant, which develops very deep root system. The morphological study on the seedlings of this species indicated close relationship between the shoot and root traits. E. arundinaceus strains with thick stem performed high bleeding rate.

**Metabolite profiling of shoot extracts, root extracts, and root exudates of rice plant under phosphorus deficiency**

Tawaraya, K.4; Horie, R.2; Saito, A.2; Shinano, T.3; Wagatsuma, T.2; Saito, K.6; Oikawa, A.4

1Yamagata University, Wakamamachi, I-23, Tsuruoka, 9978555, Japan; 2Yamagata University, Japan; 3National Agricultural Research Center for Hokkaido Region, Japan; 4RIKEN Plant Science Center, Japan

Metabolite profiling of shoot extracts, root extracts, and root exudates of rice plant with capillary electrophoresis/time-of-flight mass spectrometry (CE-TOF MS) clarified active release of many metabolites in response to phosphorus deficiency.

**Contribution of Cd-EDTA complexes to cadmium root uptake: a modelling and experimental approach**

Custos, J.M.1; Sterckeman, T.1; Moyne, C.2; Treillon, T.1

1ENSAIA, Nancy Université, INRA, 2, avenue de la Forêt de Haye - BP 172, Vandœuvre-lès-Nancy cedex, 54505, France; 2ENSEM, Nancy Université, CNRS, 2, avenue de la Forêt de Haye - BP 160, Vandœuvre-lès-Nancy cedex, 54504, France

Cd uptake by maize in the presence of EDTA was measured and simulated in hydroponics and in soil. Addition of EDTA dramatically decreased Cd root uptake, as complex dissociation at the rhizoplan could not compensate the Cd\(^{2+}\) chelation. Cd-EDTA complexes were absorbed according to a linear kinetics.

**Sucrose: a signal for formation and function of cluster roots in white lupin?**

Wang, Z.R.1; Neumann, G.1; Shen, J.B.2

1Institute of Crop Science (340h), University of Hohenheim, Germany; 2Department of Plant Nutrition, China Agricultural University, China

Sucrose was investigated as signal in inducing cluster roots formation by artificial culture. Using sterile culture, Wang et al. demonstrates sucrose can induce cluster roots formation even under P-sufficient condition but which are not functional in organic acid exudation and PEPC activity.
Non-continuous root diameter distributions in perennial ryegrass (Lolium perenne L.)
Zobel, R.
USDA-ARS, 1224 Airport Rd, Beaver, United States

Perennial ryegrass root systems are best characterized as a summation of a series of normal distributions. The resulting dataset would consist of a series of records each containing 4 values: 1) frequency, 2) mean diameter 3) average height, and 4) average standard deviation.

P226

The role of nutrient foraging in understory shrub invasions of northeastern North America
Caplan, J.S.; Ehrenfeld, J.G.; Grabosky, J.C.
Department of Ecology, Evolution, and Natural Resources, Rutgers University, 14 College Farm Rd., New Brunswick, 08901, United States

Nutrient foraging may contribute to the invasive success of understory shrubs by providing advantages in exploration and acquisition of nutrients. Through studies of root proliferation and 3D architecture, we investigated the foraging capabilities of shrubs in northeastern North America.

P227

The impact of soil condition and rootstocks on morphological and anatomical root traits in avocado.
Fassio, C; Cautin, R; Perez, A; Castro, M
Montenegro, G
Pontificia Universidad Catolica de Chile, Vicuña Mackenna 4860, Santiago, Chile; Pontificia Universidad Catolica de Valparaiso, Chile

The research comprised quantitative and qualitative analyses of a mature plant root system in the field through determining the number, length and dry matter of the particular components of the root system and some traits of the anatomical structure of the different root types found.

P228
Phosphorus uptake of different wheat genotypes intercropped with fababean in an acidic soil
Zhang, D.; Wang, Y.; Tang, L.
College of Resources and Environmental Science, Yunnan Agricultural University, Jinchai Road, Kunming, 650201, China
The research was to select optimal wheat genotypes to maximize phosphorus (P) uptake facilitation in intercropping with fababean through analysing the effects of root length and Olsen P test on P uptake of intercropped wheat.
P234

Root OA, water extraction, and GxE for root depth in rice under rainfed lowland conditions
Len, W.; Cruz, R.T.; Samson, B.K.; Hampichivitaya, D.; Moroni, S.; Yamauchi, A.
1EH Graham Centre for Agricultural Innovation, Charles Sturt University, Locked Bag 588, Wagga Wagga, 2678, Australia; 2AgronomySoils and Plant Physiology Division, Philippine Rice Research Institute, Munoz, 3119, Philippines; 3International Rice Research Institute, Vientiane, Lao People’s Democratic Republic; 4Ubon Ratchathani Rajabat University, Ubon Ratchathani, Thailand; 5Graduate School of Bioagricultural Sciences, Nagoya University, Chikusa, Nagoya, 464-8601, Japan
This paper examines rice root osmotic adjustment, root traits and water extraction, GxE for root depth, and consequences for adaptation. Root OA was lower in CT9993 than IR62266. DHL differed in water extraction. GxE was complex, so different root traits are needed for different environments.
P235

Phenological and physiological plasticity of Citrus root orders under excess salinity
Rewald, B.; Ephrath, J.E.; Rachmilevitch, S.
1French Associates Institute for Agriculture and Biotechnology of Drylands, Ben-Gurion University of the Negev, Campus Sede Boqer, Midreshet Ben Gurion, Israel; 2French Associates Institute for Agriculture and Biotechnology of Drylands, Ben-Gurion University of the Negev, Israel
Phenotypic root traits known to influence uptake processes are modified root order-specific under salinity. The importance of root orders for water uptake changed under salinity from root tips towards higher root orders.
P229

Analyzing root structure and function of sugar beet and barley non-invasively with MRI and PET
Metzner, R.; van Dusschoten, D.; Bühlner, J.; Jahnke, S.
IBG-2 Plant Sciences, Forschungszentrum Jülich, Forschungszentrum Jülich GmbH, Jülich, 52425, Germany
Development of root structure and function in soil are studied in barley and sugar beet with Magnetic Resonance Imaging and Positron Emission Tomography. Images allowed for extracting development of root geometry, spatial distribution, internal structure and carbon allocation.
P230

Modelling root water uptake based on matric flux potential and root resistance
de Jong van Lier, Q.; dos Santos, M.A.; Durigon, A.
Biosystems Engineering, University of São Paulo, C.P. 9, Piracicaba, 13489-900, Brazil
Root water uptake distribution over depth has been estimated from soil water matric flux potential and root density. A root resistance term was introduced in a root water extraction model, making model performance to increase, especially when contrasting conditions were present at different depths.
P232
An approach for the improvement of root aerenchyma formation in wheat by genetic transformation
1NARO Institute of Crop Science, 2-1-18 Kannondai, Tsukuba, 305-8518, Japan; 2NARO Institute of Livestock and Grassland Science, 768, Senbonmatsu, Nasushiobara, 329-2793, Japan; 3Graduate School of Bioagricultural Sciences, Nagoya University, Furo-cho, Chikusa, Nagoya, 464-8601, Japan; 4Japan International Research Center for Agricultural Sciences, 1-1 Ohwashi, Tsukuba, 305-8686, Japan
We are now trying to improve root characters of wheat by means of genetic transformation. There is an advantage of transgenic approach to investigate the complex characters, waterlogging tolerance in wheat.
P238

The Effects of Anthropogenic Nitrogen Deposition on the Ecological Functionality of Ectomycorrhizal Fungi
Smith, A.; Lilleskov, E.
1School of Forest Resources and Environmental Science, Michigan Technological University, 1400 Townsend Dr, Houghton, United States; 2United States Department of Agriculture, United States
P244

Underground hyphal network in agricultural soils is important for growth and nutrient uptake by plants
Zhang, J.; Fu, Z.; Liu, W.; Li, X.
1China Agricultural University, Haidian Yuanmingyuan West Road No.2, Beijing, 100193, China; 2China Agricultural University, China
Using the rotating tube method, Zhang et al., was able to demonstrate that underground hyphal network is critical for seedling growth and nutrient uptake in agricultural soils.
P245

Characterization of a Cytosolic Peroxiredoxin Induced by Meloidogyne hapla Infection in Tomato Roots
Maheux, E.; Dorion, S.; Belair, G.; Matton, D.P.; Rivoal, J.
1IRBV, Université de Montréal, 4101 rue Sherbrooke est, Montréal, H1X 2B2, Canada; 2Agriculture et Agroalimentaire Canada, 430 Boulevard Gouin, St-Jean-sur-Richelieu, J3B 3E6, Canada
Peroxiredoxins are ubiquitous thiol-dependent peroxidases. Maheux et al. cloned and characterized a cytosolic peroxiredoxin. They show this enzyme detoxifies hydrogen peroxide in vitro and is up-regulated by nematode infection in tomato roots.
P246

Rhizobacteria can control Criconemoides xenoplax
Moura, A.; Mota, M.; Moreno, S.; Somavila, L.; Gomes, C.
1Phytossanity, Universidade Federal de Pelotas, DFs/FAEM - Universidade Federal de Pelotas, Pelotas, 96010-970, Brazil; 2Embrapa CPACT, Pelotas, Brazil
Search for bacteria to control C. xenoplax was carried out by in vivo. Most bacteria reduced the reproduction factor. They resulted in 50 to 75% of reduction. Surprisingly the best treatments were isolated from onion seed (DFs306), from Tagetes sp. rhizosphere (DFs1341) and from buck soil (DFs886).
P247

Rice/nematode interactions using association mapping
Dimkpa, S.; Price, A.H.
Institute of Biological and Environmental Sciences, University of Aberdeen, Aberdeen, United Kingdom
The studies revealed a significant variation in the distribution of the alleles within five rice subpopulations and also revealed a significant variation between cultivars for number of nematode galls formed upon infection.
P248
Gas Exchange and Stomatal Response of Root Parasitic Weed *Striga hermonthica* and Sorghum under Water Stress

Inoue, T.; Yamauchi, Y.; Eltyeb, A.A.; Samejima, H.; Babiker, A.G.T.; Sugimoto, Y.

1Arid Land Research Center, Tottori University, 1930 Hamasaka, Tottori, 680-0001, Japan; 2Graduate School of Agricultural Science, Kobe University, Rokkodai, Nada, Kobe, 657-8501, Japan; 3College of Agricultural Studies, Sudan University of Science and Technology, P.O Box 71, Shambat, Khartoum North, Sudan

Root parasitic weed *S. hermonthica* maintained higher transpiration rate and greater stomatal aperture on both surfaces of the leaf than its sorghum host under soil water stress, which may result in maintaining water and solute transfer from the host to the parasite.

P253

Variation of phosphorus (P) efficiencies and mycorrhizal dependence of maize cultivars bred in different years

Feng, G.; Yang, Y.

1China Agricultural University, No2 Yuan Ming Yuan Xi Lu, Haidian District, Beijing, 100193, China; 2College of Natural Resource and Environmental Science, China Agricultural University, No2 Yuan Ming Yuan WR, Haidian, Beijing, China

Mycorrhizal dependencies were found to be generally lower in landraces than those of single cross hybrids but higher in low P efficiency cultivars than those of high P efficiency cultivars.

P254

Characterization of plant growth promoting Rhizobacteria associated with wheat from saline soil

Omar, N.

Microbiology, Soils, Water and Environment Research Institute, ARC, 9 El-Gamaa St, Giza, 12619, Egypt

The inoculation with the PGPR isolate HML, *Pseudomonas fluorescens* and *B. polymyxa* significantly alleviated the deleterious effects of salinity stress and leaf rust disease on wheat cultivar Giza-139.

P255
**Poster Session 2**

**The effect of strain and concentration of Azotobacter on growth index of root in durum wheat cultivars**
Soleymanifar, A.¹; Tavassoli, A.²; Piri, I.³
¹Payame Noor University, sistan & balochestan, khash, Iran, Islamic Republic of; ²payame noor, Department of Agriculture, Payame Noor University, PO Box 19395–4697, Tehran, I.R. of Iran, Iran, Islamic Republic of; ³Department of Agriculture, Payame Noor University, Zahedan, Iran, Islamic Republic of.

Information obtained from this study show that the roots of durum wheat respond differently to different levels of concentration and type of strains of Azotobacter. The optimum levels for the inoculum to roots due to the cultivars of strains of bacteria are determined.

P256

**Metal accumulation and root distributions of Silene vulgaris (Moench) Garcke growth in artificially polluted soils**
Pérez-Sanz, A.¹; Alonso, J.²; García, P.²; Gil Díaz, M.M.³; Lobo, M.C.²
¹IMIDRA, Finca “El Encín”, A-II Km 38.200, 28800, Alcalá de Henares, Madrid, Spain; ²IMIDRA, Spain; ³Facultad de Veterinaria UCM, Spain

An experiment was conducted in two soils to understand root distribution and metal accumulations of Silene vulgaris. Most of the metal that was taken up was accumulated in roots, followed by rhizomes, and strongly affected by metal and soil characteristics.

P258

**Bioavailability of zinc and phosphorus in calcareous soils: Influence of citrate exudation**
Duffner, A.; Temminghoff, E.J.M.; Hoffland, E.
Soil Quality Department, Wageningen University, Droevedaalsesteenweg 4, Wageningen, 6708 PB, Netherlands

Cluster root formation and citrate exudation is not a multiple stress response of white lupin at low zinc and phosphorus bioavailability in calcareous soils. However, exuded citrate triggered by low phosphorus supply can, dependent on the type of soil, mobilize Zn from a calcareous soil.

P259

**Photosynthesis effect on nitrous oxide fluxes from the soil-rhizosphere continuum of beech and ash**
Schützenmeister, K.¹; Jungkunst, H.F.²; Gansert, D.²; Fender, A.C.¹
¹Department of Ecology and Ecosystem Research, University of Göttingen, Grisebachstr. 1, Göttingen, 37077, Germany; ²Department of Landscape Ecology, University of Göttingen, Goldschmittstr. 5, Göttingen, 37077, Germany

Plants influence greenhouse gas fluxes from soils by changing conditions in the soil. Biogeochemicals influence microbial production and consumption from GHG gases in soils. We tested if ash and beech differ in their influence and the response of photosynthesis activity on rhizosphere net GHG fluxes.

P260

**Rhizospheric phosphatase activity of grassland poaceae grown under contrasting water and phosphorus supply**
Fort, F.¹; Cruz, P.²; Stroia, C.²; Jouany, C.¹
¹INRA, BP 52627, Castanet-Tolosan, 31326, France; ²Faculty of Agriculture, Banat University of Agriculture, Cayea Aandului nr.119, Timioara, 300645, Romania

Functional trait measurements on grass roots allowed us to identify species displaying capture or conservation strategies for resource acquisition. With contrasting P and water availability these species display significantly different root phosphatase activity.

P261

**Root morphology plasticity determines crop fitness in competition for phosphorus between species in intercropping system**
Zhang, C.C.; Zhang, X.J.; Shen, J.B.; Zhang, F.S.
Plant Nutrition, China Agricultural University, NO2 Yuanmingyuan Xilu, Haidian District, Beijing, 100193, China

Root architecture is important in phosphorus acquisition by plants. Using two greenhouse studies, Zhang et al. demonstrate that the difference in root morphology plasticity determine crop fitness in competition for phosphorus between species in intercropping system.

P262
**Poster Session 2**

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**Effects of long-term tillage and mineral P fertilization on AMF development and community structure**

Sheng, M.; Lalande, R.; Hamel, C.; Ziadi, N.

1Soils and Crops Research and Development Centre, Agriculture and Agri-Food Canada, 2560 Hochelaga Blvd., Quebec City, G1V 2J3, Canada; 2Semiarid Prairie Agricultural Research Center, Agriculture and Agri-Food Canada, Box 1030 Airport Rd., Swift Current, S9H 3X2, Canada

Tillage and P fertilizer stimulated AMF sporulation, reduced AMF hyphal growth and species richness, and caused a shift in AMF community structure, and these agricultural practices induced changes in AMF that could be partly explained by their effects on soil properties.

P263

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**pH modulation in successful infection of host by mycorrhizal and pathogenic fungi**

Mucha, J.; Ratajczak, E.; Guzicka, M.; Zadworny, M.

Institute of Dendrology, Polish Academy of Sciences, ul. Parkowa 5, Kornik, 62-035, Poland

Pathogen caused pH acidification in symplast and apoplast of P. sylvestris cell and accumulation of \( \text{H}_2\text{O}_2 \) and \( \text{O}_2^- \). Mycorhizal fungus, however, evoke symplast alkalization and weaker apoplast alkalization and increase in \( \text{H}_2\text{O}_2 \) production at later stage of incubation.

P265

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**Fungal mechanisms in phosphate solubilization**

Bahri-Esfahani, J.; George, T.; Hillier, S.; Gadd, G.

1The James Hutton Institute, Invergowrie, Dundee, DD2 5DA, United Kingdom; 2The James Hutton Institute, Craigiebuckler, Aberdeen, United Kingdom; 3Molecular Microbiology, College of Life Sciences, University of Dundee, Dundee, DD1 5EH, United Kingdom

Phosphorus (P) is an essential nutrient for plant development; deficiencies in soil P limit agricultural crop yields worldwide. This research examines fungal mechanisms of phosphate solubilization from sparingly-soluble P sources and shows that soil fungi may be beneficial to plant acquisition of P.

P266

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**Biodiversity of ectomycorrhiza types with different nitrogen load on three larch species grown under two phosphorus levels**

Wang, X.; Mao, Q.; Qu, L.; Tamai, Y.; Koyama, A.; Wantanabe, M.; Koike, T.

1Graduate School of Agriculture, Hokkaido University, Japan; 2Research Center for Eco-Environment Sciences, Chinese Academy Sciences, China; 3Research Faculty of Agriculture, Hokkaido University, Japan; 4Natural Resource Ecology Laboratory, Colorado State University, United States; 5Research Faculty of Agriculture, Hokkaido University, Japan

We evaluated the biodiversity of ectomycorrhiza infected with three Larix species, including newly developed hybrid, grown in immature volcanic ash with different levels of fertilization. Ectomycorrhiza diversity was significantly different among the three species, and affected by fertilization.

P267

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**Quantification of fungal hyphae in soil - a new method**

Børja, I.; Svetlík, J.; Eldhuset, T.D.; Lange, H.; Kidder, F.N.; Godbold, D.L.

1Norwegian Forest and Landscape Institute, P. O. Box 115, 1431 Ås, Norway; 2Mendel University in Brno, Zemedelská 3, 61300 Brno, Czech Republic; 3Presidentgate 6, 0474 Oslo, Norway; 4Institute for Forest Ecology, BOKU, 1180 Vienna, Austria

Fungi are the main degraders of organic matter. To quantify hyphae in soil, Børja et al. used nylon nets vertically inserted into the soil to immobilize the hyphae and developed a system for automatic image analysis and determination of the hyphal mat area.

P268
**Chlorophyll fluorescence to evaluate the effect of the combination PGPR and Rhizobium in bean plants**

Bacarin, M.1; Correa, B.2; Martinazzo, E.3; Schafer, J.3; Moura, A.3
1Botany, Universidade Federal de Pelotas, IB Universidade Federal de Pelotas, Pelotas, 96010-970, Brazil; 2Phytossancty, Universidade Federal de Pelotas, IB Universidade Federal de Pelotas, Pelotas, 96010-970, Brazil; 3Phytossancty, Universidade Federal de Pelotas, IB Universidade Federal de Pelotas, Pelotas, 96010-970, Brazil

The chlorophyll fluorescence was used to identify growth promotion by PGPR used alone or with rhizobia. The performance index, identified behavior for the double treatments in relationship to Semia4077. The best treatments increased the maximum quantum yield of electron transport.

P269

**Community structures in Rhizospheres of Arabidopsis thaliana**

Früh, E.1; Wubet, T.1; Buscot, F.3; Scheel, D.2; Schrey, S.D.1; Hampp, R.3; Fiedler, H.P.2
1Soil Ecology, Helmholtz Centre for Environmental Research - UFZ, Theodor-Lieser-Straße 4, Halle, 06120, Germany; 2Leibniz Institute of Plant Biochemistry, Weinberg 3, Halle, 06120, Germany; 3Physiological Ecology of Plants, University of Tuebingen Institute of Microbiology and Infection Medicine, Auf der Morgenstelle 28, Tübingen, 72076, Germany

Composition of bacterial and fungal community is highly diverse. With the help of different accession lines of Arabidopsis thaliana we try to identify microbial community structures by using multi-tag targeted high throughput pyrosequencing.

P270

**Mycorrhizal diversity and fine root growth of beech seedling growing under different temperature conditions**

Štraus, I.; Bajc, M.; Martinović, T.; Kraigher, H.
Slovenian Forestry Institute, Vecna pot 2, Ljubljana, Slovenia

Results of root growth, analyzed using Rootfly, confirmed the influence of soil temperature on growth and development of plant roots. Phylogenetic analysis of Scleroderma sp. did not provide species identification due to a possible miss-identification of GenBank data sources.

P271

**Post-fire Restoration of Soil Hydrology and Wildland Vegetation using Surfactant Seed Coating Technology**

Madsen, M.D.1; Kostka, S.2; Inouye, A.L.3; Zvirzdn, D.L.3
1USDA-Agricultural Research Services, Burns, OR 97720, United States; 2Aquatrols Corporation of America, 1273 Imperial Way, New Jersey 08066, United Kingdom; 3Department of Plant and Wildlife Sciences, Brigham Young University, Provo, United States

A novel surfactant seed coating technology (SSC) was developed that increases percolation and water retention in water repellent soils. For two bunchgrass species used in post-wildfire restoration, mean survival was increased from 0.75% (untreated) to 37% for SSC. This technology is a promising strategy for post-fire restoration success.

P272

**Variation in dry matter production and root branching ability under drought stress condition**

Kameoka, E.
Nagoya university, Chikusa, Nagoya 464-8601, Japan

Cypress, Tainung67, LTH and N22 had better shallow root branching ability then Nipponbare and FR13 A under mild drought stress conditions in a shallow soil layer. The branching ability should have been expressed by maintenance of each nodal root elongation, promoting lateral root development.

P273

**Can a root pressure probe measure the hydraulic resistance of root, soil, and their interface?**

Kim, Y.X.1; Zarebanadkouki, M.2; Vetterlein, D.1; Carminati, A.2
1Department of Soil Physics, Helmholtz Centre for Environmental Research – UFZ, Theodor-Lieser-Strasse 4, Halle, 06120, Germany; 2Department of Crop Sciences, University of Göttingen, Buesgenweg 2, Göttingen, 37077, Germany

How to measure the hydraulic resistance of roots, soil, and their interface? Combining a root pressure probe and neutron radiography, Kim et al. measured the hydraulic resistance of the whole system and tried to quantify the contribution of each components.

P274
Ecosystem services provided by plant root carbon combined with soil drying and wetting
Smucker, A.J.M.1; Park, E.J.2; Sissoko, F.3
1Michigan State University, United States; 2Gyeonggi Research Institute, Korea; 3Bamako Research Institute, Mali
Plant root exudates strengthen and preserve soil aggregates and increase soil C sequestration while reducing respiration during multiple drying and wetting cycles. Increased dissolved organic carbon alters the abundance of unique microbial ribotypes within internal regions of aggregates.
P275

Field evaluation of the plasticity in root system development under various intensities of drought stress in rice
Kameoka, E.; Yamauchi, A.
Nagoya University, Graduate School of Bioagricultural Sciences Nagoya University, Chikusa, Nagoya, Japan, Nagoya, 464-8601, Japan
Among OryzaSNP pane, greater plasticity in root system development was shown in Cypress, Tainung67, LTH and N22, which was triggered particularly under mild drought stress and expressed in lateral roots. Such plasticity was found to largely determine the dry matter production.
P276

Modeling of root water uptake responses in relation to soil water content
Huber, K.1; Vanderborght, J.1; Javaux, M.1; Schroeder, N.1; Vereecken, H.1
1Agrosphere Institute, Forschungszentrum Jülich, Germany; 2Julich Supercomputing Centre, Forschungszentrum Jülich, Germany
Two different responses of root water uptake towards soil water content status are being explored using a 3D model that concurrently simulates water flow in soil and root system.
P277

Water and phosphorus stress: contrasting effects on root functional traits and between grass functional groups
Fort, F; Jouany, C; Cruz, P
INRA, BP 52627, Castanet-Tolosan, 31326, France
Root resources acquisition strategies are defined with functional traits. However traits respond differently to water and phosphorus stress and the magnitude of the response depends on the plant’s functional group. Grass species develop different root strategies to cope with P and water stress.
P278

Root system characterization in sweet sorghum and maize using two different methodologies
Zegada-Lizarazu, W.1; Alessandro, Z.2; Andrea, M.2
1Department of Agroenvironmental Science and Technology, University of Bologna, 44, Viale G. Fanin, Bologna, 40127, Bologna, 40127, Italy; 2Department of Agroenvironmental Science and Technology, University of Bologna, Italy
A fast and relatively easy method to estimate root biomass and function from pictures taken in rhizotrons was developed for two main cereals. Significant and positive correlations were found.
P279

A novel image analysis toolbox enabling quantitative analysis of root system architecture
Lobet, G.1; Pagès, L.2; Draye, X.1
1Earth and Life Institute, Université Catholique de Louvain, Croix du Sud, 2 - L7-05-11, Louvain-la-Neuve, 1348, Belgium; 2Plantes et Systèmes de Culture Horticoles, INRA Avignon, France
We present here a novel, semi-automated image analysis software to streamline the quantitative analysis of root growth and architecture of complex root systems. The software combines a vectorial representation of root objects with a powerful tracing algorithm.
P280
**Imaging and characterization of crop root systems using electrical impedance tomography: A feasibility study**

Weigand, M.1; Pfeifer, J.; Nagel, K.A.; Zimmermann, E.; Walter, A.; Kemna, A.

1Applied Geophysics, University of Bonn, Nussallee 8, Bonn, 53115, Germany; 2Plant Sciences (IBG-2), Forschungszentrum Jülich, Jülich, 52428, Germany; 3Central Institute for Electronics (ZEL), Forschungszentrum Jülich, Jülich, 52428, Germany; 4Institute of Agricultural Sciences, ETH Zürich, Zürich, 8092, Switzerland

Weigand et al. present a feasibility study on using electrical impedance tomography as a non-destructive tool for characterizing root growth and function in rhizotrons. They find that root systems can be spatially delineated and that electrical polarization depends on root mass and activity.

P281

**Nitric oxide promotes plant lateral root formation: a hypothetic mechanism**

Wu, C.; Liu, L.

1College of Horticulture & Gardenology, Yangtze University, 88 Jingmi Rd, Jingzhou, 434025, China; 2Yangtze University, China

P282
**Poster Session 2**

Thursday, June 28, 2012
13:45-15:00hrs

**Room 1.F01**

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**Radial force development during root growth measured by photoelasticity**

Kolb, E.¹; Hartmann, C.²; Genet, P.³

¹PMMH ESPCI – CNRS UMR 7636, 10 rue Vauquelin, Paris, 75231 Paris Cedex 5, France; ²IRD - UMR 211 ‘BIOEMCO’, 46 rue d’Ulm, Paris, 75230 Paris cedex 05, France; ³UPMC Paris 6 – CNRS UMR 7618, 46 rue d’Ulm, Paris, 75230 Paris cedex 05, France

Root growth inside a pore of size comparable to radicle’s diameter was observed by time-lapse imaging and radial forces measured by photoelasticity. The constriction did not reduce roots’ axial growth while radial forces were still increasing with time with no force levelling even after 5 days.

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**CT-assisted analysis of biopores and their influence on root growth (and root dynamics)**

Blaser, S.¹; Koebernick, N.²; Weller, U.²; Vetterlein, D.²; Vogel, H.J.²; Jahn, R.³

¹Soil Physics, Helmholtz Zentrum für Umweltforschung – UFZ, Theodor-Lieser-Straße 4, Halle (Saale), 06120, Germany; ²Institut für Agrar- und Ernährungswissenschaften, Martin-Luther-Universität Halle-Wittenberg, Von-SEckendorff-Platz 3, Halle (Saale), 06120, Germany

Biopores (BPs) are large continuous pores, developed and maintained mainly by roots or earthworms. X-ray tomography enables non-destructive imaging and analyzing of BPs. First results show that roots respond to the presence of BP and show preferential growth and fast elongation within these pores.

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**Root development in relation with soil strength and macroporosity; study case of a cultivated sandy soil.**

Hartmann, C.; Lecoq, L.E.; Maeght, J.L.; Pierret, A.; Sipaseuth, N.; Sengtaheuanghoung, O.; Noble, A.D.; Jaillard, B.

IRD (Institut de Recherche pour le Dévelopement), 32 rue Varagnat, Bondy, 93143, France; ²IRD, Lao People’s Democratic Republic; ³NAFRI, Lao People’s Democratic Republic; ⁴IWMI, Lao People’s Democratic Republic; ⁵INRA, France

Root system extension depends on soil strength and porosity. Relative importance of these two factors was studied experimentally. Increased root development was indeed obtained by hardpan softening but fragmentation was more efficient. Both treatments also affected carbon allocation to root system.

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**Root Anchorage: predicting and measuring soil-root interaction during uprooting**

Duckett, N.

Civil/Geotechnical Engineering, University of Dundee, Nethergate, Dundee, DD1 4HN, United Kingdom

A novel calculation model, which combines numerical modelling and foundation design techniques with laboratory testing and PIV analysis, is proposed for quantifying and predicting the response of a root system to uprooting, the simplest form of root anchorage failure.

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**Root-length densities of spring wheat (Triticum aestivum L.) and mallow (Malva sylvestris L.) in subsoil biopores**

Perkons, U.; Kautz, T.; Köpke, U.

Institute of Organic Agriculture, University of Bonn, Katzenburgweg 3, 53115 Bonn, Germany

In the subsoil tap roots of mallow showed a higher percentage of root growth in biopores than fibrous wheat roots. It is therefore concluded that the relevance of biopores in the subsoil for facilitating root growth might depend on the specific characteristics of the root system.
Maize growth and development as affected by tillage systems under Mediterranean conditions

Ozpinar, S.; Ozpinar, A.
1Farm Machinery, Çanakkale Onsekiz Mart University, College of Agriculture, Çanakkale, 1720, Turkey; 2Plant Protection, Çanakkale Onsekiz Mart University, College of Agriculture, Çanakkale, 1720, Turkey

Rototiller significantly improved crop growth after for maize. Much of root dry matter in all tillage is determined at topsoil followed by 10 to 20 cm and 20 to 30 cm. The lowest root was found for plough at the 20 to 30 cm depth. Tillage had no significant effect on biomass and crop growth rate, except the initial growing stage.

P290

Root architecture of two sorghum varieties differ than drought stress tolerance

Sine, B.; Muller, B.
1Centre d’Étude Régional pour l’Amélioration de l’Adaptation à la Sécheresse (CERAAS), Thiès Escale, Thiès, 3320, Senegal; 2CIRAD, Avenue Agropolis, Montpellier, 34998, Senegal

Adventitious roots number, adventitious roots ranks number, and root length density could constitute for sorghum pertinent and easily accessible drought stress tolerance criterions.

P293

Effects of soil frost on fine root growth and longevity

1Finnish Forest Research Institute, Yliopistokatu 6, Joensuu, 80101, Finland; 2AgroParisTech/INRA, UMR 518 AgroParisTech/INRA MIA, Paris, France

Short root growth and longevity of Norway spruce was studied in a 50-years old stand with different soil frost treatments. Root growth was impaired by delayed soil thawing but seemed to recover after the treatments. Median root longevity ranged from 301 to 333 days depending on the treatment.

P294

Root recovery in two blackcurrant cultivars after a period of drying out

Čereković, N.; Koefoed Petersen, K.; Lakkenborg Kristensen, H.; Brennan, R.
1Department of Food Science, Aarhus University, Faculty of Science and Technology, Kirstinebjergvej 10, Aarslev, DK-5792, Denmark; 2Cell and Molecular Sciences, The James Hutton Institute, Invergowrie Dundee, DD2 5DA, United Kingdom

Climate changes may become a limiting factor in blackcurrant production due to periods of drought stress during flowering. Two blackcurrant cultivars were found to differ in root recovery and growth of aerial parts after twelve days with no irrigation by Čereković et al.

P295

Drought Impact on Root Growth and Tracheid Structure in Norway Spruce (Picea abies (L.) Karst.)

Eldhuset, T.D.; Børja, I.; Gebauer, R.; Krokene, P.; Nagy, N.E.; Volarik, D.
1Norwegian Forest and Landscape Institute, P.O. Box 115, Ås, NO-1431, Norway; 2Institute of Forest Botany, Dendrology and Geobiocenology, Mendel University in Brno, Zemedelska 3, Brno, CZ-61300, Czech Republic

Climate change is expected to increase drought-related stress and mortality in forest trees. Eldhuset et al. demonstrate that in Norway spruce fine roots, development of ellipsoid tracheids, increased rooting depth and changed morphology are mechanisms to adapt to drought treatment.

P296

Impact of winter and spring flooding on the silver and pubescent birch seedlings

Wang, A.F.; Roitto, M.; Lehto, T.; Repo, T.
1Finnish Forest Research Institute, Joensuu Unit, Finland, Metla, PO Box 68, FI-80101, Joensuu, Finland; 2School of Forest Sciences, University of Eastern Finland, PO Box III, Joensuu, FI-80101, Finland

With global climate change, winter and spring flooding increased in Northern Europe. Spring flood in growth chamber experiment had clear effects on the growth of leaves and roots in birch seedlings. Silver and pubescent birch had different respond to winter and spring flooding.

P298
**Short-Term effects of a hypoxic hydroponic solution on gas exchange and root respiration of two Prunus rootstocks**

Toro, G.; Salazar, C.; Pino, M.T.; Pinto, M.
CEAF, Chile; 2INIA, Chile; 3CEAF, Av. Salamaca s/n, Rancagua, Chile

Hypoxia stress decreases the root respiration, that has a very dramatic effect on photosynthetically parameters, but tolerance rootstock maintains the root respiration for more time.

P299

**Future lies beneath: Introgression of rice root QTLs, water use efficiency, grain yield for durable drought tolerance**

Haradari, C.; Hittalmani, S.
1Genetics and Plant Breeding, UAS, GKVK, BANGALORE-65, Dept of GPB, UAS, GKVK, Bangalore, 560065, India; 2Genetics and Plant Breeding, University of Agricultural Sciences, College of Agriculture, GKVK, Bangalore, 560065, India

QTLs conferring root traits, water use efficiency and grain yield were introgressed using SSR markers and evaluated under moisture stress conditions to derive durable drought tolerant genotypes in rice. QTLs on chromosome 1 and 7 (L+7) performed superior than 3 and 4 QTL combinations.

P300

**Root responses of seven perennial forage species under severe soil drought**

Zwicke, M.; Bertrand, A.; Prud'homme, M.P.; Volaire, F.; Picon-Cochard, C.
1INRA-UREP, 234 avenue du Brezet, Clermont Ferrand, 63000, France; 2UMR INRA-UCEBN 950 EVA, France; 3UMR CEFE-CNRS-INRA-SupAgro, France; 4INRA-UREP, France

Drought resistance and survival were studied for seven forage species which exhibited contrasted roots systems with contrasted survival rate. Relationships between survival, SWC, root depth and distribution will be presented to characterise plant survival strategies.

P302

**Effects of nitrogen deposition combined with phosphorus deficiency on fine-root growth of three larch species**

1Graduate School of Agriculture, Hokkaido University, Japan; 2Research Faculty of Agriculture, Hokkaido University, Japan; 3Natural Resource Ecology Laboratory, Colorado State University, United States; 4Hokkaido Forestry Research Institute, Japan

We investigated increased nitrogen deposition on the development of larches grown in soils derived from volcanic ash with phosphorus deficiency. New in-growth core methods were applied to monitor the root development. Nitrogen decreased root vertical elongations and influenced fine root dynamics.

P303

**Characterization, suitability evaluation and management of ultisols for root crop production in southern Nigeria**

Aruleba, J.; Ajayi, A.S.
Crop, Soil & Environmental Sciences, Ekiti State University, Iworoko Road, Ado Ekiti, +234, Nigeria

A detailed soil survey of about 100ha of Ultisols in derived Savanna region of South Western Nigeria was carried out. The soils were found to be marginally suitable for the crops (yam, sweet potato, cassava, cocoyam etc.) that are commonly grown in the area.

P304

**Responses of Scots pine roots to wintertime flooding**

Roitto, M.; Wang, A.W.; Sutinen, S.; Lehto, T.; Repo, T.
1Finnish Forest Research Institute METLA, PO. BOX 68, Joensuu, FI-80101, Finland; 2School of Forest Sciences, University of Eastern Finland, PO Box 111, Joensuu, FI-80101, Finland

Fouding in winter did not adversely affect fine root biomass of Scots pine in the following growing season.

P306
**Changes in root system of 4 potato genotypes among 4 years and 2 soil water conditions**
Deguchi, T.1; Wangchuk, P.2; Itoh, E.3; Naya, T.3; Furukawa, K.3; Matsumoto, M.3; Kobayashi, T.3; Iwama, K.3
1Research Faculty of Agriculture, Hokkaido University, Sapporo, Japan; 2Renewable Natural Resources Research and Development Centre, Wengkhar, Mongar, Bhutan; 3Hokkaido University, Japan

Effects of climate and soil water conditions on potato root system were analyzed using data of root system for 4 years under irrigated and droughted fields. Drought, heat stress and delay of planting strongly affected root system, but effects of GxE interaction was not significant or small.

**P307**

**Root growth and respiration of a perennial grassland subjected to future climate change and extreme event**
Picon-Cochard, C.1; Augusti, A.2; Bahn, M.2; Roy, J.4
1INRA, 234 avenue du Brézet, Clermont-Ferrand, 63100, France; 2CNR, Porano, Italy; 3University of Innsbruck, Innsbruck, Austria; 4Ecotron, CNRS, Montferrier-sur-Lez, France

The aim of this work was to test the hypothesis that elevated CO₂ combined with air warming, may alleviate the negative effect of a severe soil drought. Our results show that elevated CO₂ promoted new root growth under severe soil drought, response that is essential for plant recovery.

**P308**

**ROOTOPOWER: Empowering root-targeted strategies to minimize abiotic stress impacts on horticultural crops**
Pérez-Alfocea, Francisco1; Asins, M.J.2; Thompson, A.J.3; Declerck, S.4; Rubion, F.4; Topcu, S.5; Ghanem, M.E.1; Dodd, I.6
1Consejo Superior de Investigaciones Científicas, Murcia, Spain; 2Instituto Valenciano de Investigaciones Agrarias, Valencia, Spain; 3Cranfield University, United Kingdom; 4Université catholique de Louvain, Louvain-la-Neuve, Belgium; 5Cukurova University, Adana, Turkey; 6Lancaster Environment Centre, Lancaster University, Lancaster, United Kingdom

Using recombinant inbred lines (from wild tomato relatives) and/or transgenics as rootstocks can increase crop yields (especially under abiotic stresses such as salinity and drying soil) by altering chemical root-to-shoot chemical signalling

**P310**

**Reducing Nitrogen Leaching While Maintaining Quality Turfgrass**
McMillan, M.1; Guertal , E.2; Cisar, J.3
1Aquatrols Corporation of America, Paulsboro, NJ, United States; 2Auburn University, Auburn, United States; 3University of Florida, Fort Lauderdale, United States

Soil surfactants are used to alleviate soil water repellency. Research in 2009 and 2010 demonstrated the use of an APG-E surfactant reduced nitrate leaching while maintaining or improving turfgrass quality. These results suggest the addition of an APG-E surfactant may have the added benefit of enhancing nitrogen efficiency.

**P311**

**Nutrient seed priming improves seedling growth and increases grain yield of maize exposed to low root-zone temperatures**
Neumann, G.1; Imran, M.1; Asim, M.2
1Institute of Crop Science (340i), University of Hohenheim, Fruhwirthstr. 20, Stuttgart, 70593, Germany; 2Institute of Crop Science (340i), University of Hohenheim, Fruhwirthstr. 20, Stuttgart, 70593, Germany

Seed priming with micronutrients (Fe, Zn+Mn) stimulated growth, micronutrient status and root development of maize seedlings at low root-zone temperature in hydroponics and in soil culture in rhizoboxes. Positive effects persisted under field conditions, resulting in yield increase of 10-15 %.

**P312**

**Responses of Indigenous Sorghum [Sorghum bicolor L. (Moench)] Landraces to Progressive Pre-flowering Drought Stress**
G.Egziabher, Y .; Fetene, M.
Plant Biology and Biodiversity Management Programme Unit, Addis Ababa University, Addis Ababa, 1048, Ethiopia

The stay green property has attracted scholars in drought stress tolerance studies but the contribution of root length density and architecture for plants adapted to grow using only residual moisture have been ignored.

**P313**
Is sorgoleone release linked to BNI function in sorghum?
Tesfamariam, T.; Yoshinaga, H.; Santosh, D.; Hash, C.T.; Subbarao, G.V.

Sorghum genotypes showed distinct differences for sorgoleone release and BNI activity from roots. Purified sorgoleone showed strong BNI function. Genetic exploitation for sorgoleone release could be a powerful strategy to control nitrification in sorghum production systems.

Wheat root ideotypes for improved resource use efficiency in reduced input agriculture

The New Wheat Root Ideotype project aims to identify root traits as selection criteria for reduced input cropping. Ex situ characterisation of 100 wheat genotypes indicated significant genetic variation in root size and root-depth distribution that will be examined for responses to reduced inputs.

Limitations of no-tillage winter wheat production with long-term glyphosate use in South-West Germany

Delayed degradation of herbicide residues in LT no-tillage soils contributes to re-growth problems in winter wheat.

Exploiting natural variation of the root architecture response to nitrate supply in Arabidopsis
De Pessemier, J.; Vercautern, A.; Chardon, F.; Vuylsteke, N.; Verbruggen, N.; Hermans, C.

A hypothesis that elevated CO2 could alleviate the damage caused by waterlogging, was tested using vegetative growth of soybean in 10 experiments conducted at two locations in three years. The results rejected our hypothesis.
Practical experience with instrumental measurements of root systems in large trees and forest stands
Cermák, J.; Nadezhdina, N.; Simon, J.
Mendel Univ. Brno, Czech Republic
P321

Screening and evaluation of contrasting rice varieties for growth and phosphorus acquisition in phosphorus-limiting soil
Al-Ogaidi, F.; Standing, D.; Price, A.H.
University of Aberdeen, Cruickshank Building, Aberdeen, AB24 3UJ, United Kingdom

Using subsoil/sand mix plus nutrient solution with or without phosphorus revealed that genotypes interact differently with treatments. Cultivars used were assessed for root traits in rhizotrons. Comparisons do not suggest that root architecture traits strongly affect plant growth in this experiment.
P322
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