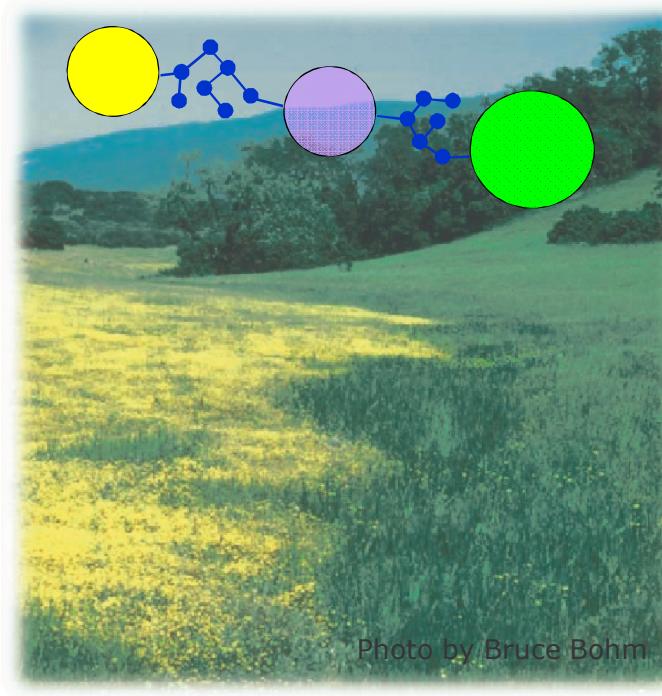


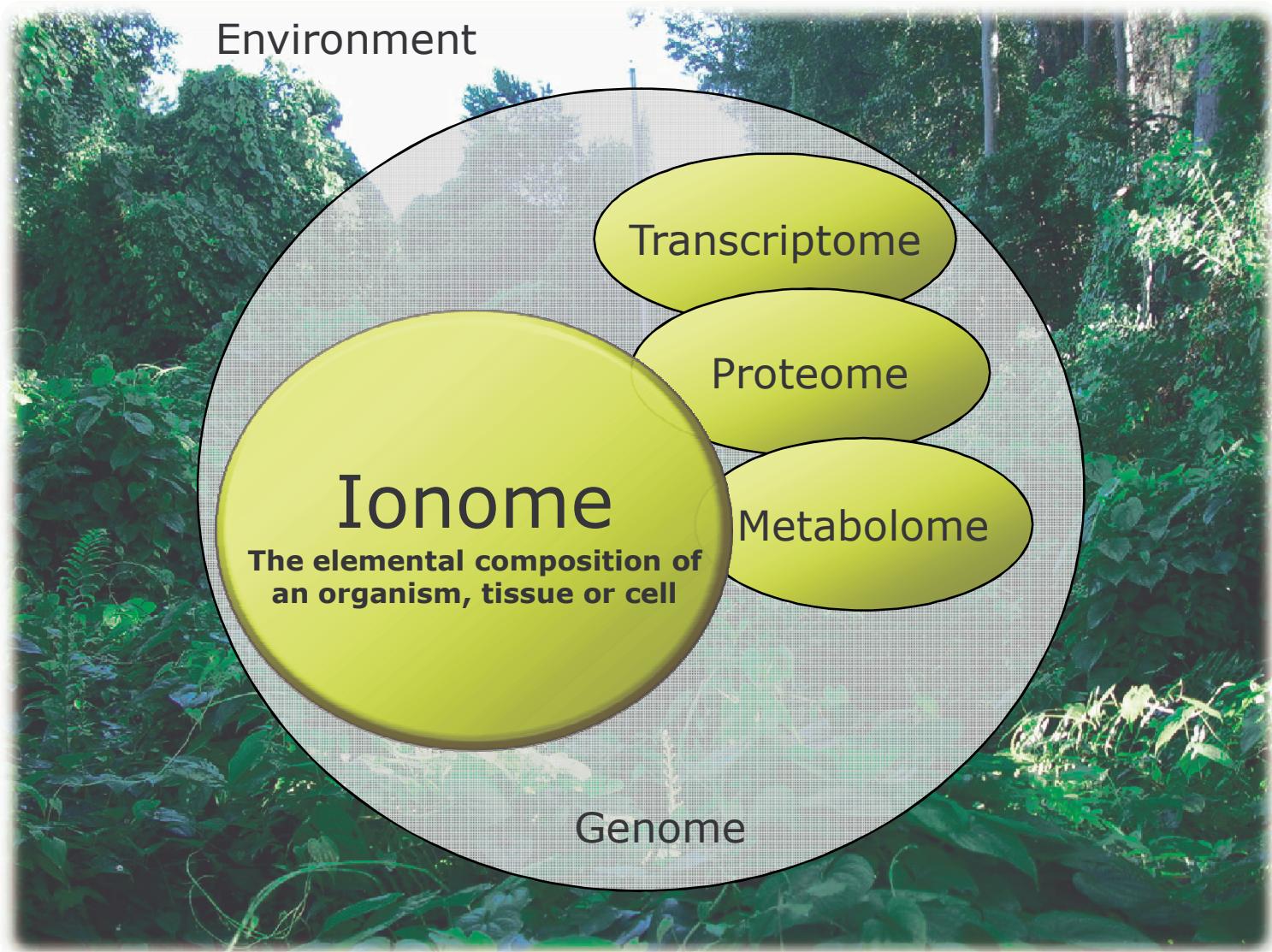
# Mapping connections between the genome, ionome and the physical landscape



David E Salt  
Purdue University, USA

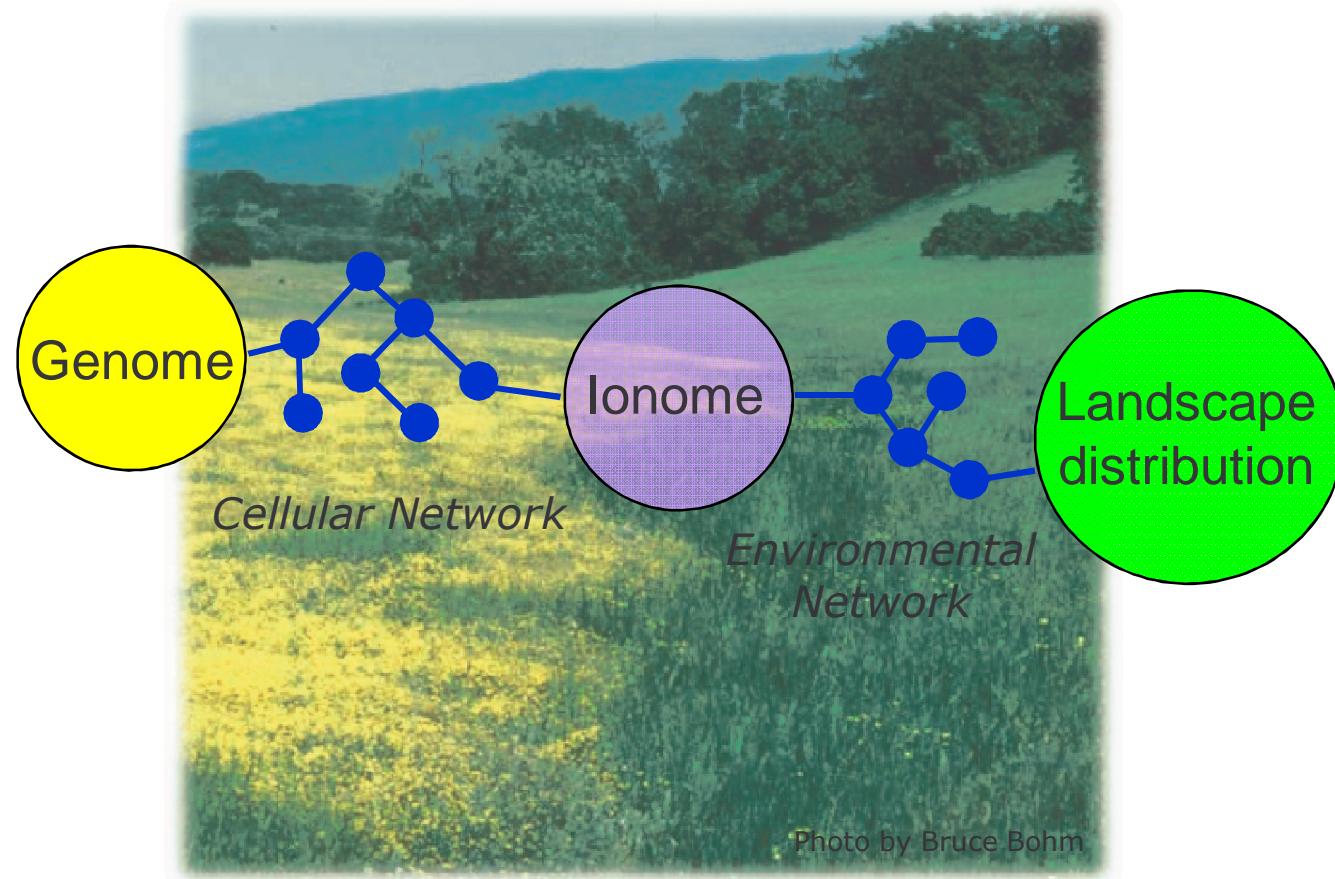


# What is the “Ionome”

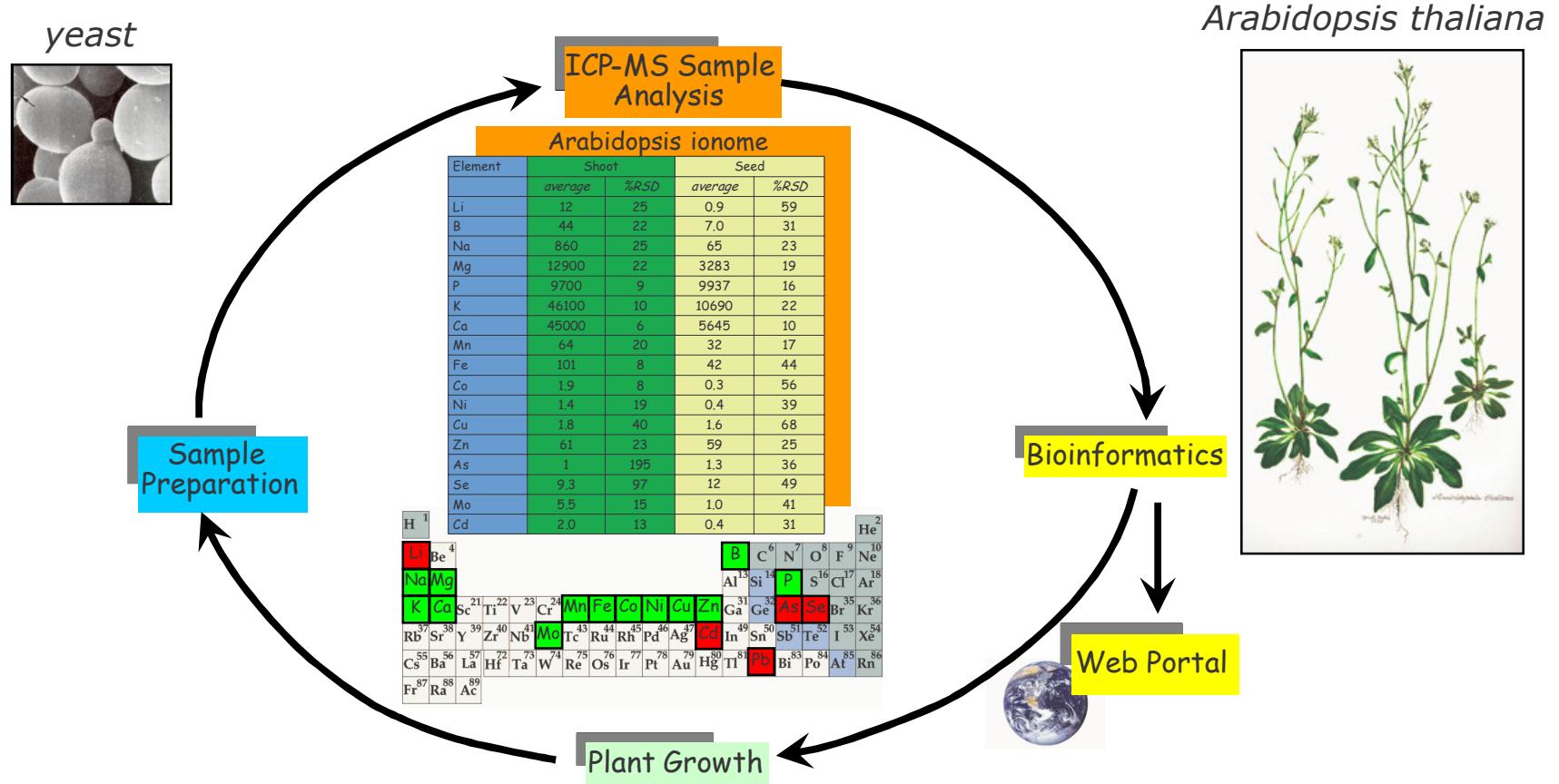


Lahner et al., *Nat Biotech* 2003

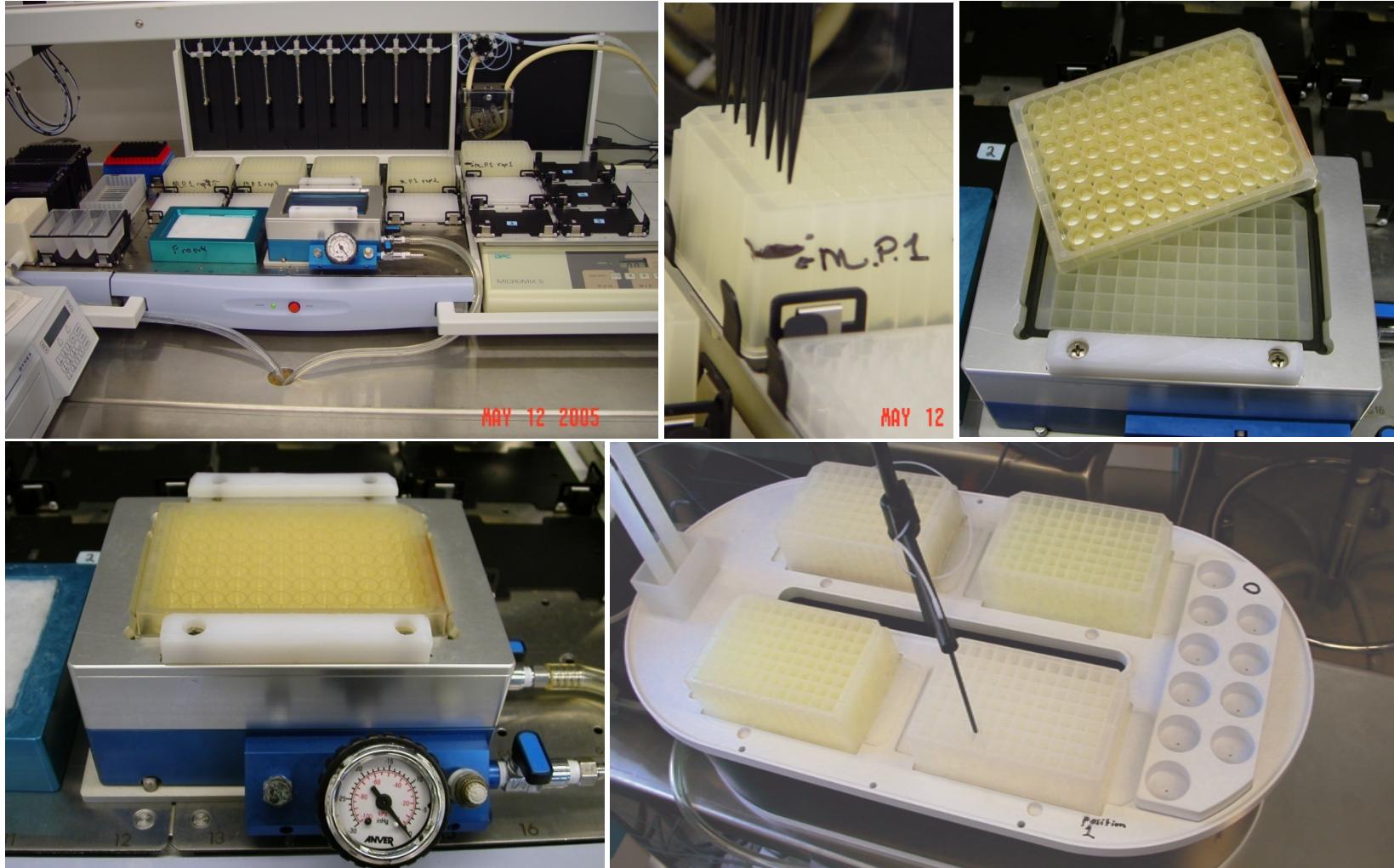
“plant adaptation to different soil types is evidence of the strong natural selection imposed by ecological discontinuities” ALFRED RUSSEL WALLACE (1858)



# Ionomics – Unraveling the networks that link the genome and the ionome



# High-throughput ionomic analysis of *Saccharomyces cerevisiae*



# [www.IonomicsHUB.org](http://www.IonomicsHUB.org)

Community HUB to share data

**PurdueIonomics**  
INFORMATION MANAGEMENT SYSTEM

[Sign Up](#)

Improving our understanding of how plants take up, transport and store their nutrient and toxic elements, collectively known as the ionome, will benefit human health and the natural environment. Here you will find curated ionomic data on many thousands of plant samples freely available to the public. If you use any of the data or information derived from it for publication or presentation purposes please cite [Baxter et al., Plant Physiology 2007](#). If you want to learn more, read our [Wikipedia entry](#).

Click on the species below to access their full databases or use the Quick Search.

**Arabidopsis Database**      **Rice Database**      **Yeast Database**

1411 total experiments  
113558 total samples  
9957 unique lines  
1690 unique genes  
1529 orders submitted  
1280 orders completed

... Coming Soon      ... Coming Soon

**PiiMS Quick Search**

Choose the database in which you would like to search

Arabidopsis    Rice    Yeast

Use the form below to search upon atg, parent, or tray number criteria. To search for multiple trays use a comma to separate tray numbers

Gene Name/ATG Number:   
 Line Name:   
 Tray Number(s):

**See who is using PiiMS**

Visitor locations

ClustrMaps™ Click to see

**Interested in PiiMS?**

- [Watch a video demonstration and also experiment with a fully function demonstration version of PiiMS online!](#)
- [Learn how to submit seeds for Analysis in our facilities and how to search the database](#)
- [A schematic representation of our pipeline](#)
- [A demo database of PiiMS](#)

**Team Members**

- David Salt
- Ivan Baxter
- Mourad Ouzzani
- Gomez Marshall
- Maged Zereba
- Brett Lahner
- Elena Yakubova

**News & Events**

Last posts from the Ionomics blog.

- [New seed grant to develop collaborative tools](#)  
published on January 08, 2009  
We are pleased to announce that along with...
- [Sorry for loss of PiiMS service over the last 5-day](#)  
published on October 20, 2008  
Over the last 5-days system administrators ha...
- [The Figure Reviewers Didn't Like](#)  
published on August 25, 2008  
In our previous attempts to get the Fe model ...
- [PiiMS is now all open source](#)  
published on August 13, 2008  
We have just rolled out the new version of Pi...
- [Fe&P model paper is online!](#)  
published on August 13, 2008  
Our paper showing how we can use the ionome t...

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**Publications**

- [The leaf ionome as a multivariable system to detect a plant's physiological status](#)  
Ivan R. Baxter, Olga Vitkik, Brett Lahner, Balasubramanian...
- [Variation in Molybdenum Content Across Broadly Distributed Populations of \*Arabidopsis thaliana\* Is Controlled by a Mitochondrial Molybdenum Transporter \(MOT1\)](#)  
Baxter I, Muthukumar B, Park HC, Buchner P, Lahne...
- [Natural Variants of ATHKT1 Enhance Na+ Accumulation in Two Wild Populations of \*Arabidopsis thaliana\*](#)  
Ana Rus, Ivan Baxter, Balasubramanian Muthukumar...
- [Purdue Ionomics Information Management System \(PIIMS\): An Integrated Functional Genomics Platform](#)  
I. Baxter, M. Ouzzani, S. Orsun, B. Kennedy, S.S....
- [Genomic scale profiling of nutrient and trace elements in \*Arabidopsis thaliana\*](#)  
Brett Lahner, Jiming Gong, Mehrzad Mahmoudian, El...

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# e-Laboratory

## controlling workflow and data acquisition

**PURDUE UNIVERSITY**

**Purduelonomics INFORMATION MANAGEMENT SYSTEM**

Welcome | eLaboratory | eManagement | Data Search | Advanced Search | Order Form | My Profile | Logout

**TRAY ADMINISTRATION**

**PLANTING**

**HARVESTING**

**DRYING**

**MS ANALYSIS**

**PlantingStage**

Active Tray: 989

**General Information**

Date Planted: 07/17/2006 mm/dd/yyyy  
Planted By: Elena Yakubova  
Tray Notes: Ivan Baxter

**Environment**

Growth Media: 19f Soil  
Light Intensity: 90.0  $\mu$ E  
Day Length: 10.0 hours  
Temperature: 23.0  $^{\circ}$ C  
Humidity: 44.0 %  
Fertilization: 0.25xHoagland's Mo Type2+1ml Fe HBED/L

**Pot Information**

Please select a tray map to be used for the experiment. After selecting the tray map, click the save button to enable entering pot level information.

Tray Map: Map 20sp  
Status: All required pot information complete  
➡ POT EDITOR

Please note that changing the tray map will delete any pot level information previously stored about this experiment.

**SaveStage**

**IONOMICS eLabNotebook**

**TrayIndex**

Tray Search:  Tray No.  Tray Range  Status

Tray No.	P	H	D	A	Updated
459	Y	Y	Y	Y	08/14/2006
508	Y	Y	Y	Y	06/24/2005
509	Y	Y	Y	Y	07/01/2006
521	Y	Y	Y	Y	07/18/2006
528	Y	Y	Y	Y	06/24/2005
543	Y	Y	Y	Y	06/24/2005
581	Y	Y	Y	Y	07/19/2006

**PlantingStage**

◀ EXIT POT EDITOR  
Active Tray 989

**Pot Information**

null	a	b	c	d	e	f	g	h	i	a	b	c	d	e	f	g	h	i	null
------	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	------

**Currently Editing Pot(s): g**

Line Reference: SALK\_049132 Display Line Information  
Mutant Provider: Arabidopsis BRC  
Customer: ivan baxter  
Plant Description:

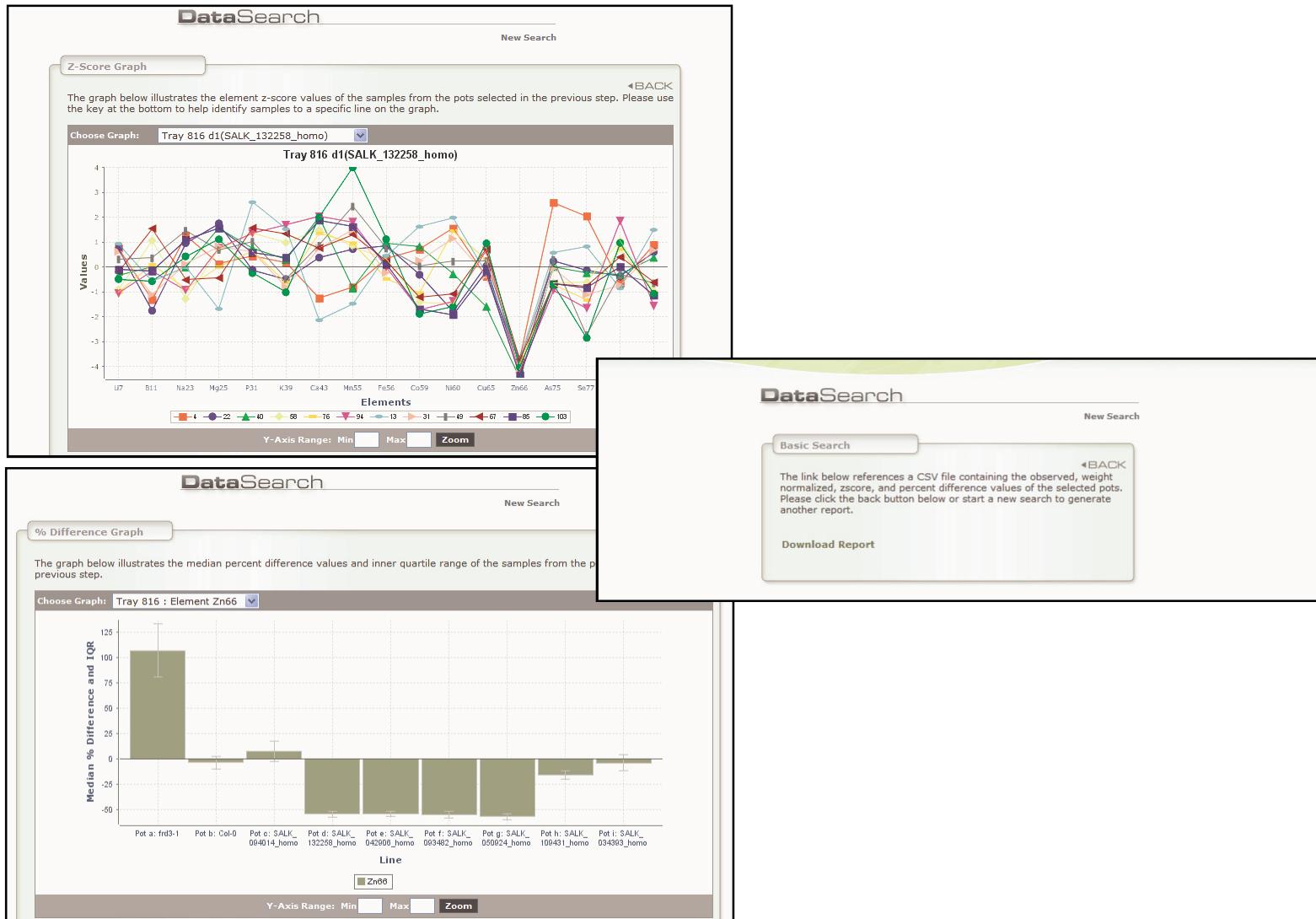
**Customer Orders**

Order	Customer	Line	Submitted On
790	mezzari	SALK_119328_homo	2006-05-26
920	mezzari	SALK_123490_homo	2006-05-26
1210	ibaxter	cpr1-1	2006-06-06
1220	ibaxter	cpr6-1	2006-06-06
1230	ibaxter	nsbC	2006-06-06

**Baxter et al., Plant Physiol 2007**

# Search

## Data visualization and download



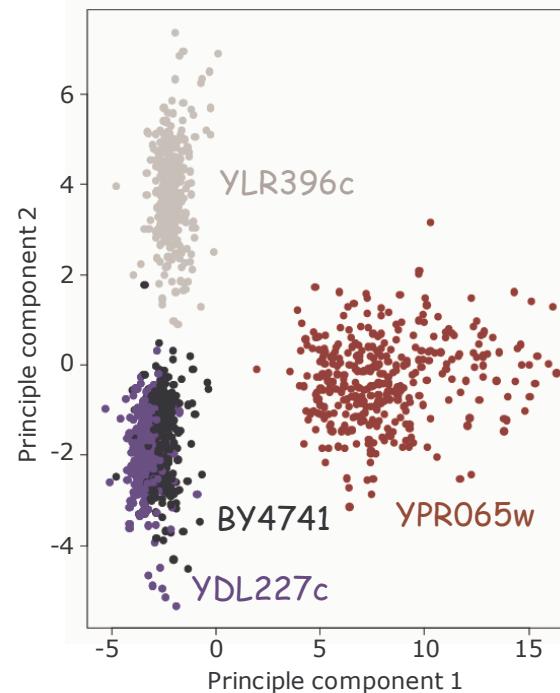
# Cellular Networks: Genes to ionome in yeast

## Ionomic analysis of the complete *S. cerevisiae* deletion collection

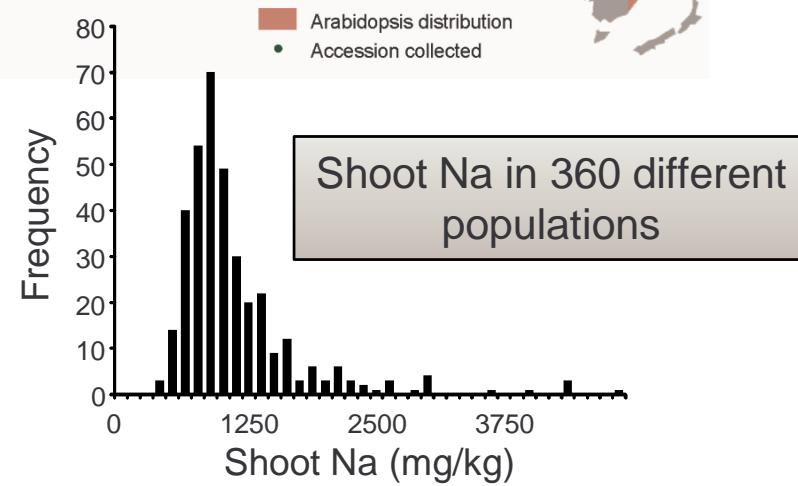
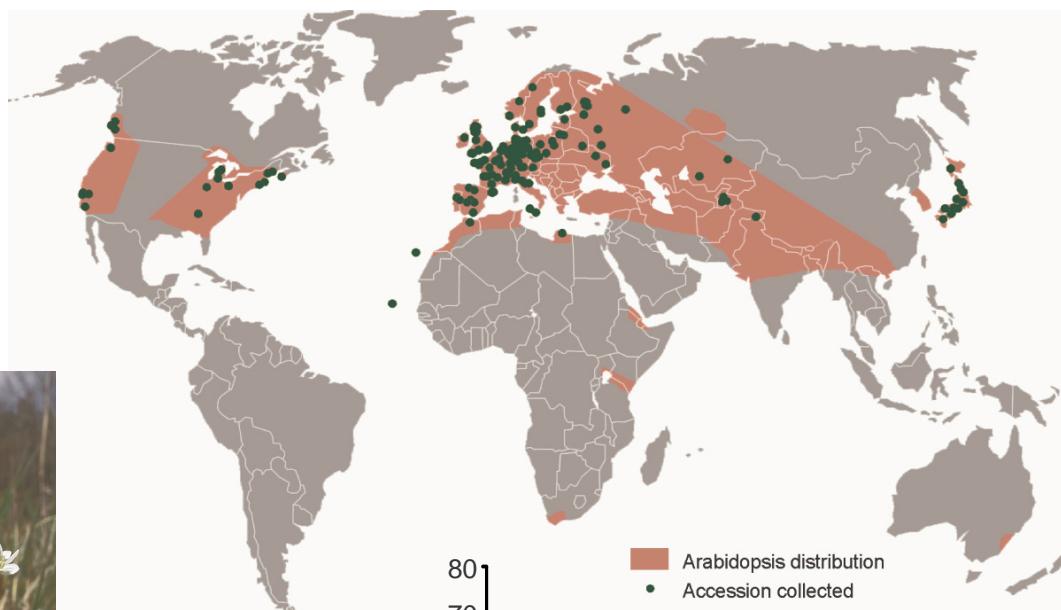


Discrimination of 4 positive control strains of yeast used throughout the complete screen (~260 plates) based on their ionomic profiles

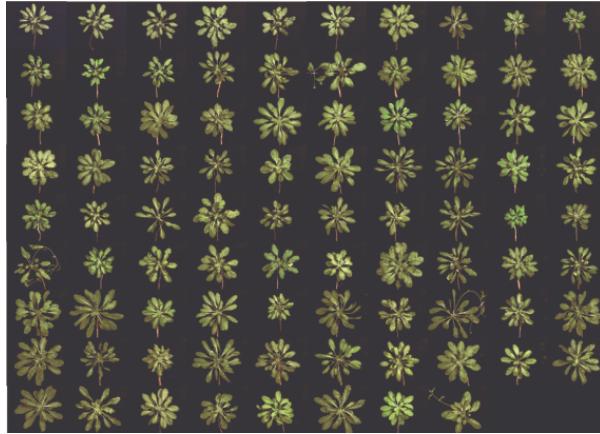
- Na, Mg, P, S, K, Ca, Mn, Fe, Co, Ni, Cu, Zn, Mo, Cd analyzed
- 20 lines per plate ( $n = 4$ )
- 240 lines per week (12 plates)
- Full collection of 5153 deletion strains completed in 6 months.



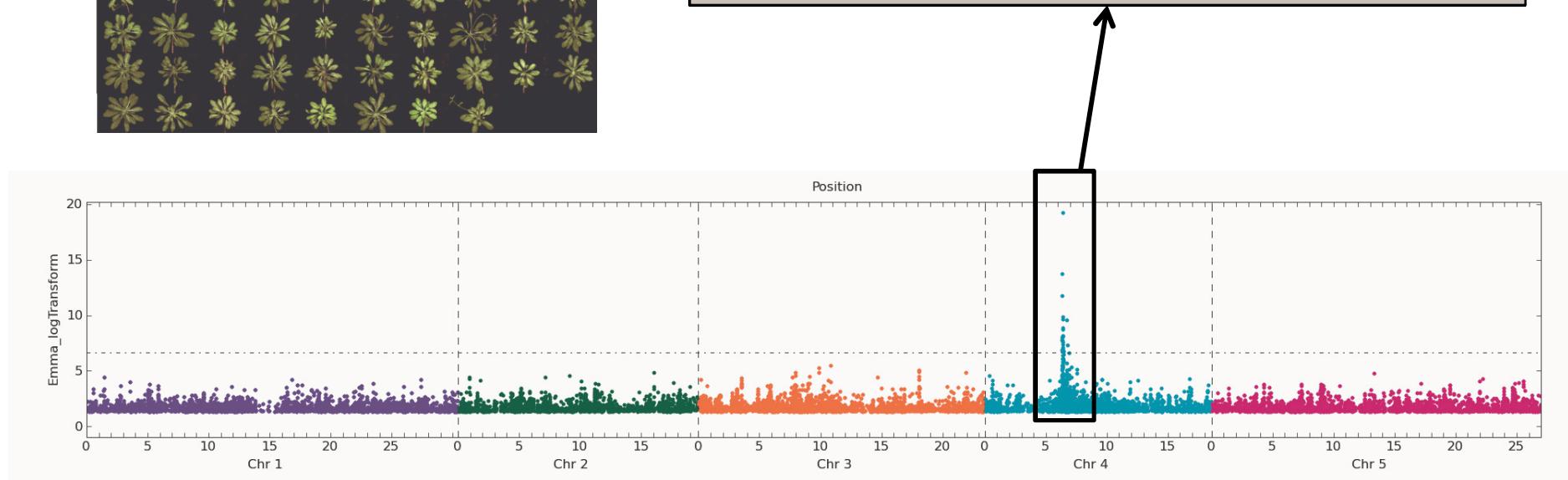
# Networks connecting genes the ionome and the landscape



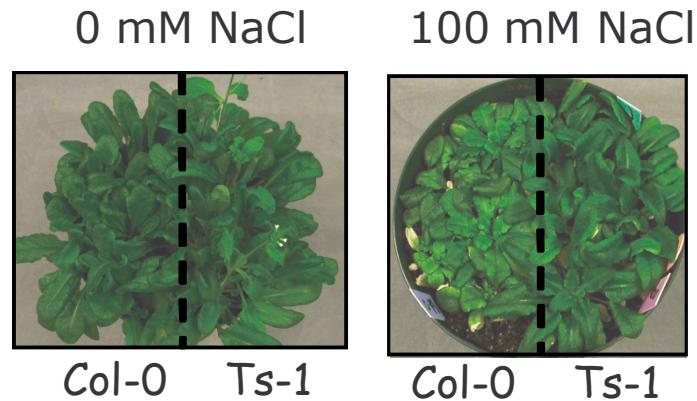
# Genome-wide genetic association analysis for genes controlling Na accumulation



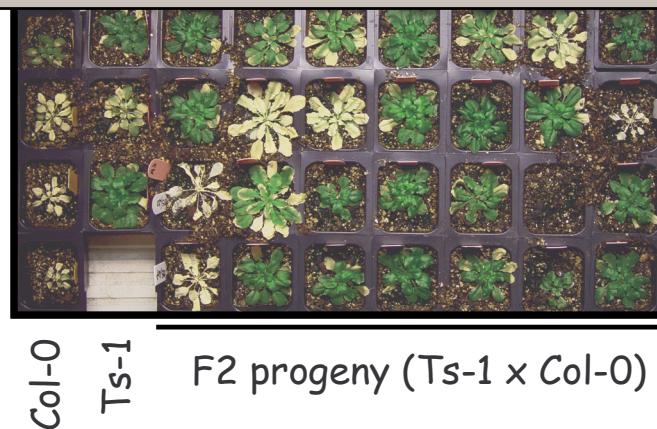
High Na locus maps to *HKT1* a known Na-transporter



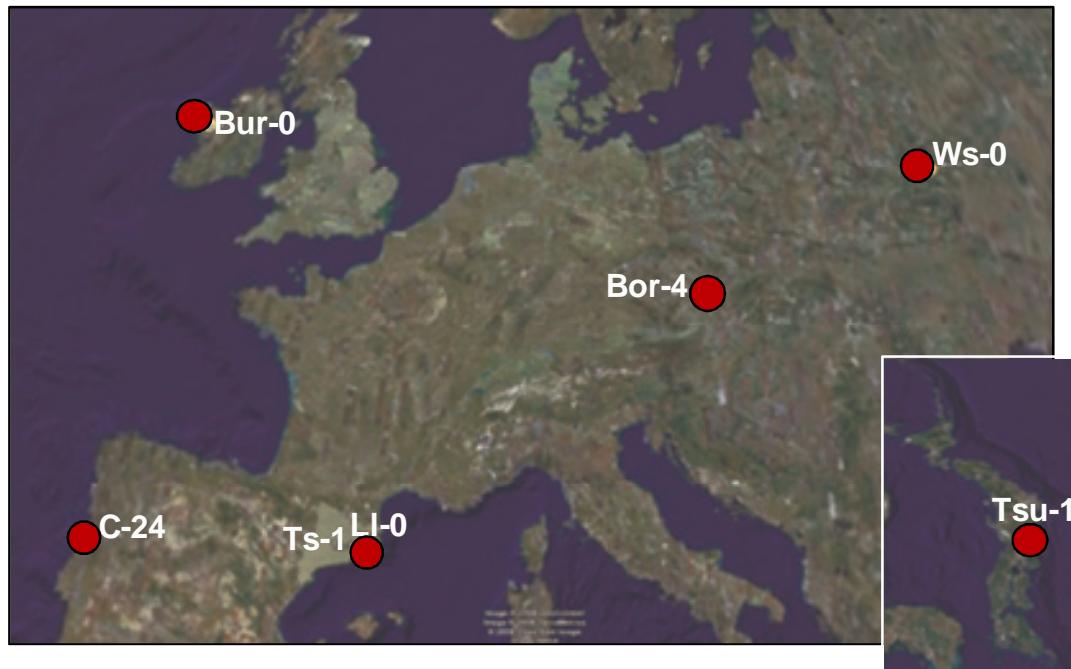
# *HKT1* gene variant also controls Na tolerance



Segregation of NaCl tolerance

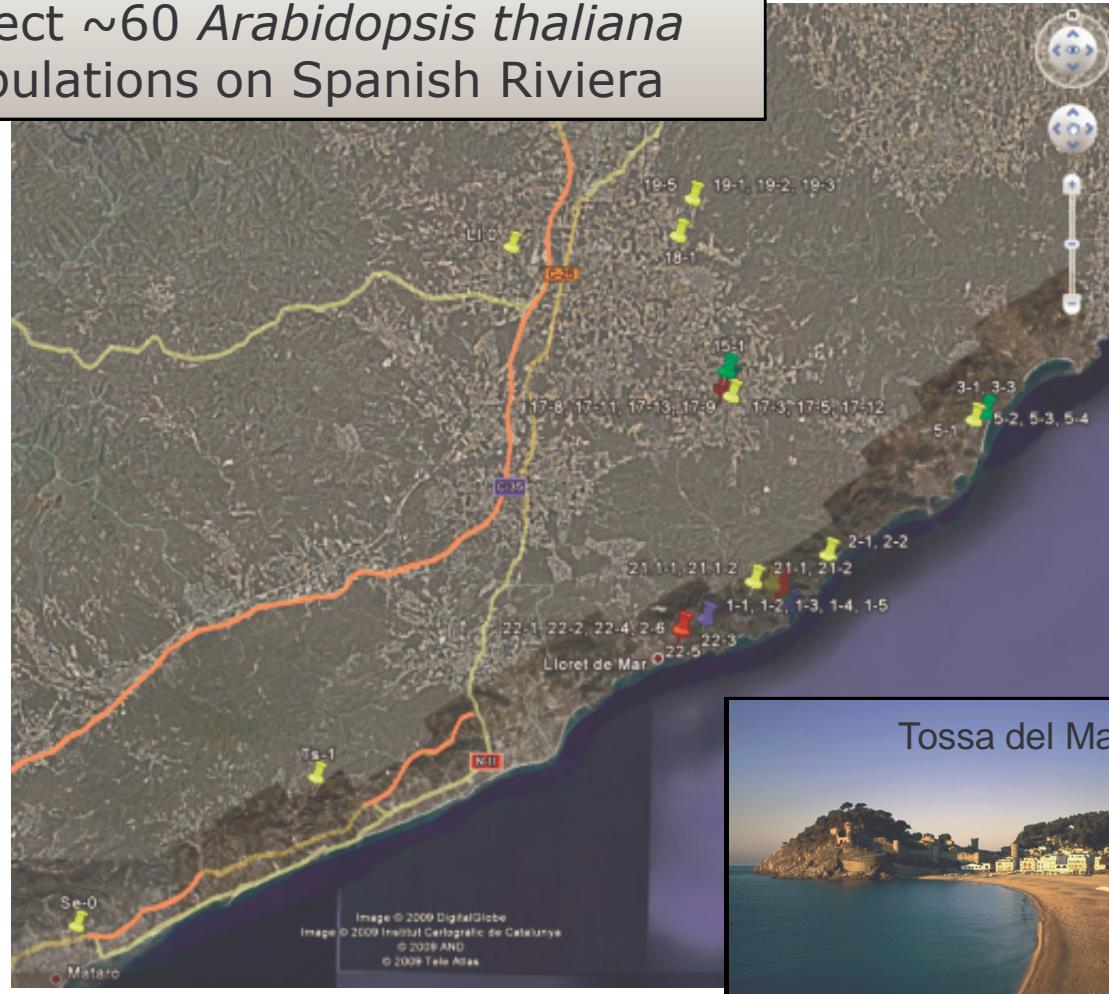


# *HKT1* variant broad geographic distribution

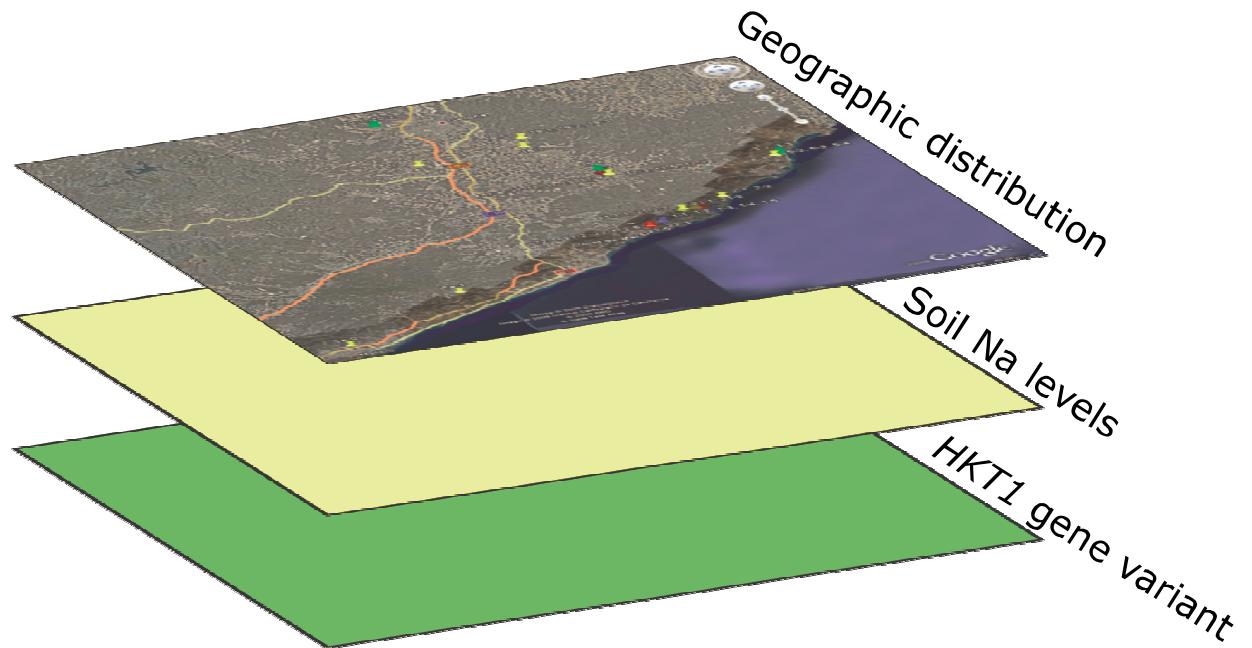


# Networks connecting genes (*HKT1*), the ionome (Na) and the landscape

Collect ~60 *Arabidopsis thaliana* populations on Spanish Riviera



# Association of *HKT1* gene with soil Na and geographic location



Does *HKT1* determine the landscape distribution of *Arabidopsis* on the Spanish Riviera ?

# Acknowledgments

## Salt Laboratory

Dr Ivan Baxter

Dr Ana Rus

Dr Muthukumar

Jessica Brazelton

Elena Yakubov

Marina Tikhonova

**Brett Lahner (Arabidopsis)**  
**John Danku (yeast)**  
**Analytical Chemists**



**Dr Mourad Ouzzani** (Purdue, Cyber Center)

Brad Kennedy, Genez Marshall

**Dr Olga Vitek** (Purdue University)

Danni Yu

**Dr Kirsten Bomblies** (MacArthur Fellow, Harvard)

**Dr Magnus Nordborg** (University Southern California)

