

# How a model genome can change your life?



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# *Arabidopsis thaliana*

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Sequence since 2000, but already model plant since 1980



George Redei  
Missouri



George Redei  
Barbara McClintock

1957: He was the only person in the world to work with Arabidopsis.  
2013: ~ 16,000 laboratories worldwide are pursuing research with Arabidopsis



George Redei



Patrick Sorgeloos

# First International Symposium on Arabidopsis Research in Göttingen, April 21–24, 1965



# Second International Symposium on Arabidopsis Research in Frankfurt am Main, September 13–15, 1976.



# International Conference Arabidopsis Research

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Yearly ICAR meeting



**24<sup>th</sup> ICAR 2013**  
SYDNEY AUSTRALIA

# ICAR 2013

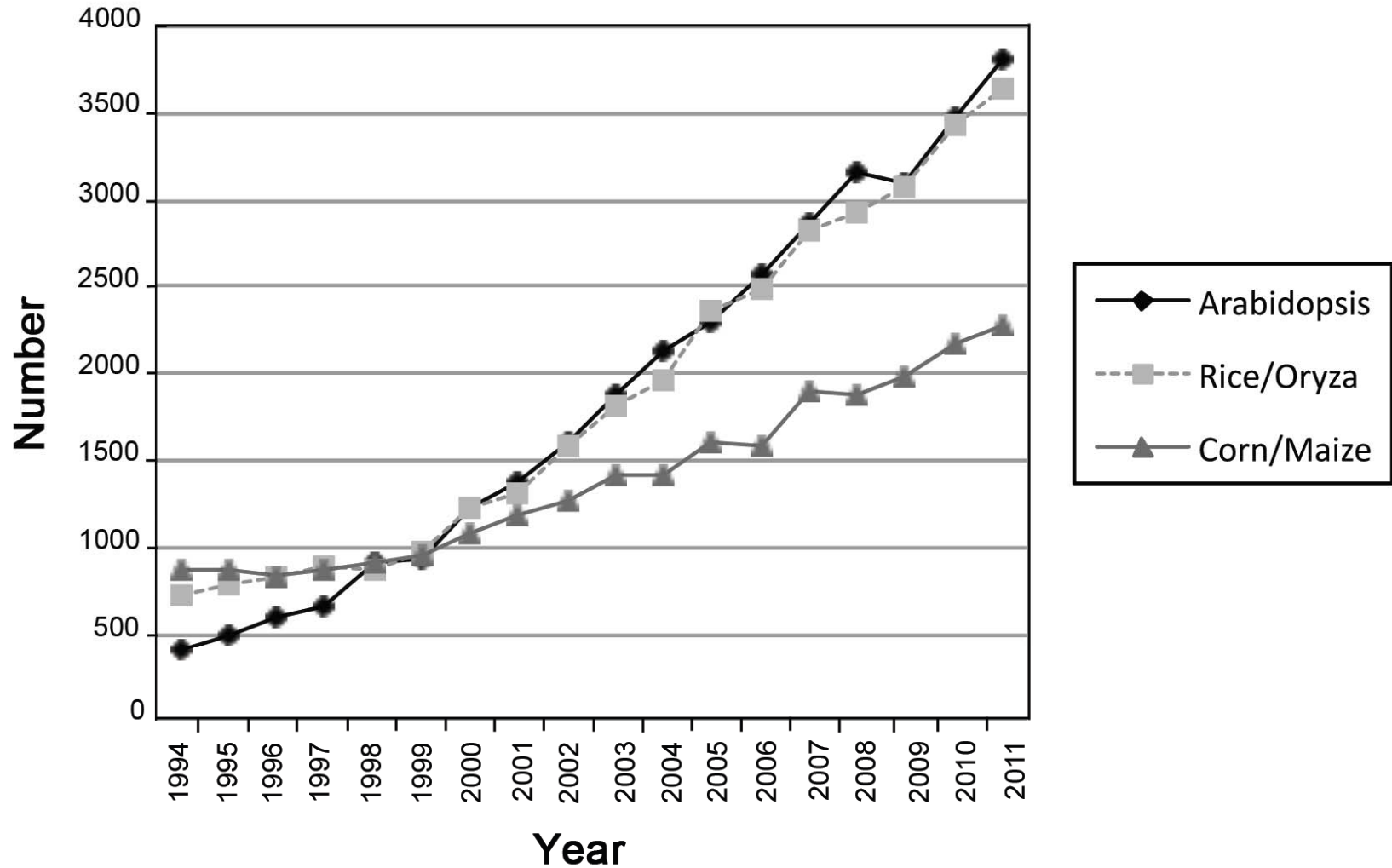
24th International Conference  
on Arabidopsis Research

24 to 28 June 2013 Sydney Convention and Exhibition Centre



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# Model Organism Journal Publications 1994-2011



Model Organism Research Papers Published in Peer-reviewed Journals  
[Data source: NCBI-PubMed: Searches: Arabidopsis; Rice/Oryza; Corn/Maize]



**Why is Arabidopsis so successful  
as a model organism?**

# Natural features

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- Small sized plant
- short generation cycle ~ 3 months
- natural inbreds
- Very amenable to genetic engineering
- small size genome ~120 Mb
- Only 5 chromosomes

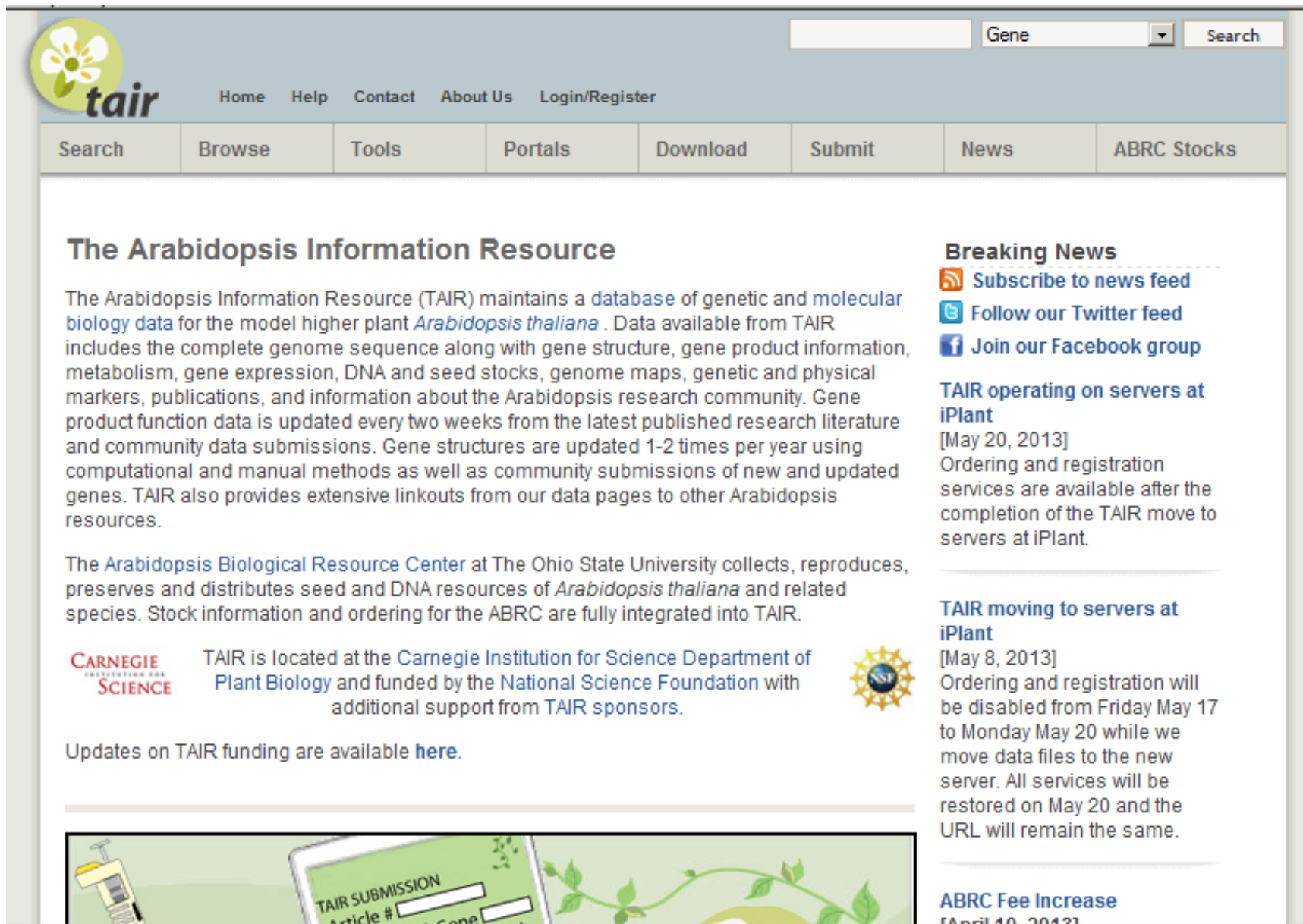


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# The Arabidopsis Information Resource





The screenshot shows the TAIR website homepage. At the top left is the TAIR logo, a green flower with the text 'tair' below it. To the right of the logo is a search bar with the text 'Gene' and a 'Search' button. Below the logo and search bar is a navigation menu with links: Home, Help, Contact, About Us, and Login/Register. Below the navigation menu is a secondary menu with buttons for Search, Browse, Tools, Portals, Download, Submit, News, and ABRC Stocks. The main content area is titled 'The Arabidopsis Information Resource' and contains a paragraph describing the resource. To the right of the main content is a 'Breaking News' section with three items: 'Subscribe to news feed', 'Follow our Twitter feed', and 'Join our Facebook group'. Below the 'Breaking News' section are two news items: 'TAIR operating on servers at iPlant' and 'TAIR moving to servers at iPlant'. At the bottom of the main content area is a section for funding information, including the Carnegie Institution for Science logo and the NSF logo. At the bottom of the page is a banner for 'TAIR SUBMISSION' with a form for article number and gene name. The bottom of the screenshot shows a Windows taskbar with the Internet Explorer icon and the text 'Internet | Pr'.

**The Arabidopsis Information Resource**




The Arabidopsis Information Resource (TAIR) maintains a [database](#) of genetic and [molecular biology data](#) for the model higher plant *Arabidopsis thaliana*. Data available from TAIR includes the complete genome sequence along with gene structure, gene product information, metabolism, gene expression, DNA and seed stocks, genome maps, genetic and physical markers, publications, and information about the Arabidopsis research community. Gene product function data is updated every two weeks from the latest published research literature and community data submissions. Gene structures are updated 1-2 times per year using computational and manual methods as well as community submissions of new and updated genes. TAIR also provides extensive linkouts from our data pages to other Arabidopsis resources.

The [Arabidopsis Biological Resource Center](#) at The Ohio State University collects, reproduces, preserves and distributes seed and DNA resources of *Arabidopsis thaliana* and related species. Stock information and ordering for the ABRC are fully integrated into TAIR.

 TAIR is located at the [Carnegie Institution for Science Department of Plant Biology](#) and funded by the [National Science Foundation](#) with additional support from [TAIR sponsors](#). 

Updates on TAIR funding are available [here](#).

**Breaking News**

-  [Subscribe to news feed](#)
-  [Follow our Twitter feed](#)
-  [Join our Facebook group](#)

**TAIR operating on servers at iPlant**  
[May 20, 2013]  
Ordering and registration services are available after the completion of the TAIR move to servers at iPlant.

**TAIR moving to servers at iPlant**  
[May 8, 2013]  
Ordering and registration will be disabled from Friday May 17 to Monday May 20 while we move data files to the new server. All services will be restored on May 20 and the URL will remain the same.

**ABRC Fee Increase**  
[April 10, 2013]

**TAIR SUBMISSION**  
Article #   
Gene



Search	Browse	Tools	Portals	Download	Submit	News	ABRC Stocks
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## Gene Model: AT4G37630.1 [Help]

Date last modified	2013-02-04
Name	AT4G37630.1
Name Type	orf
Gene Model Type	protein_coding
TAIR Accession	Gene:2120080
Description	core cell cycle genes; a quantitative trait gene for endoreduplication.
Chromosome	4
Locus	AT4G37630 (Note: use this locus link to see all functional annotations, associated gene models, markers and ESTs).



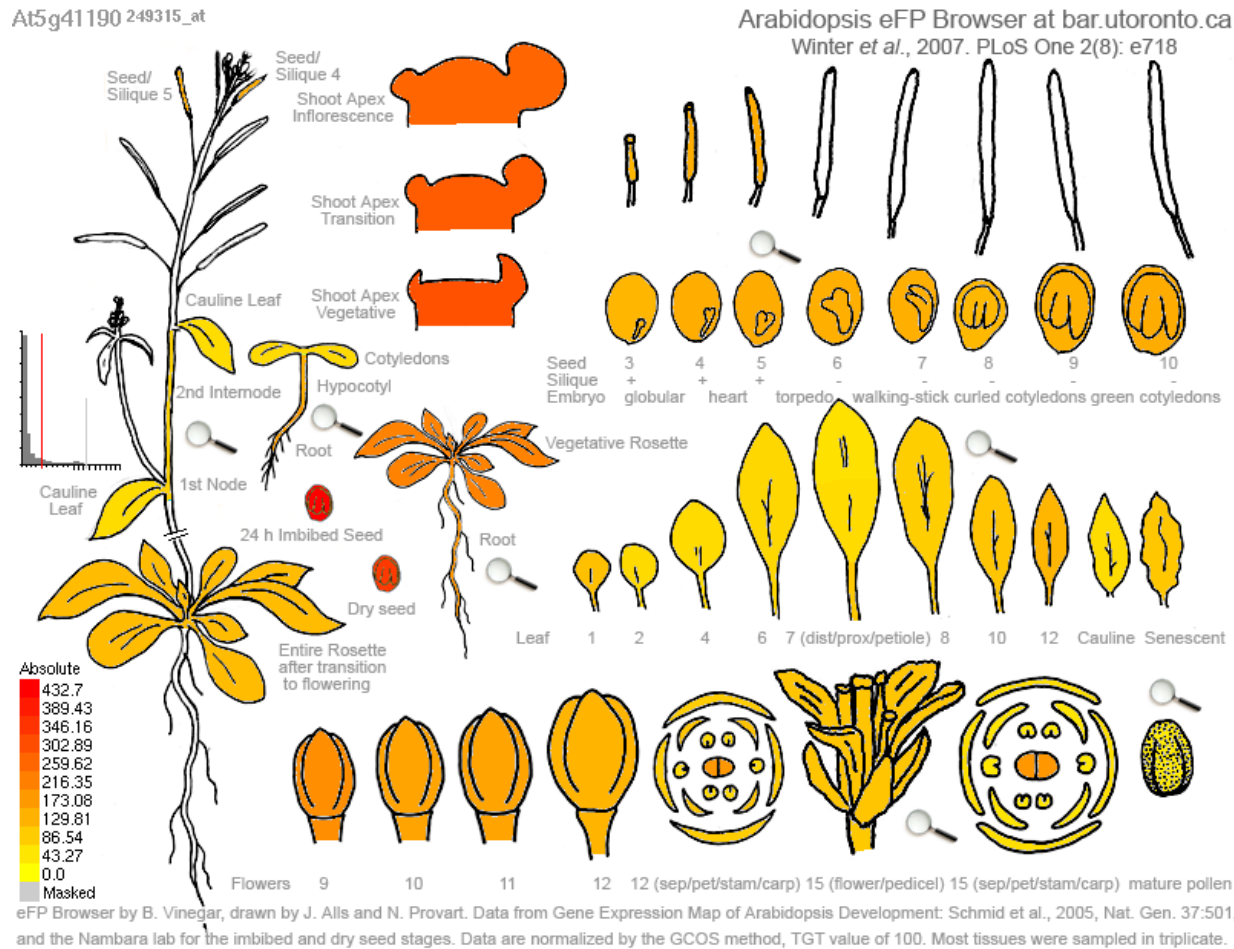
Symbols	symbol	full name
	CYCD5;1	CYCLIN D5;1

Annotations	Category	Relationship Type	Keyword
	GO Cellular Component	located in	nucleus
	Plant structure	expressed in	cultured plant cell
	<a href="#">Annotation Detail</a>		

Protein Data	name	Length(aa)	molecular weight	isoelectric point	domains( # of domains)
	AT4G37630.1	323	37166.5	5.1509	Cyclin-like:IPR013763(3) Cyclin D:IPR015451(1) Cyclin, N-terminal:IPR006671(1)

Map Locations	chrom	map	map type	coordinates	orientation	attrib
	4	AGI	nuc_sequence	17679279 - 17681202 bp	forward	<a href="#">details</a>
	4	F19F18	assembly_unit	49628 - 51551 bp	forward	

# Bio-Analytic Resource for Arabidopsis



eFP Browser by B. Vinegar, drawn by J. Alls and N. Provart. Data from Gene Expression Map of Arabidopsis Development: Schmid et al., 2005, Nat. Gen. 37:501, and the Nambara lab for the imbibed and dry seed stages. Data are normalized by the GCOS method, TGT value of 100. Most tissues were sampled in triplicate.

# Arabidopsis stock centers

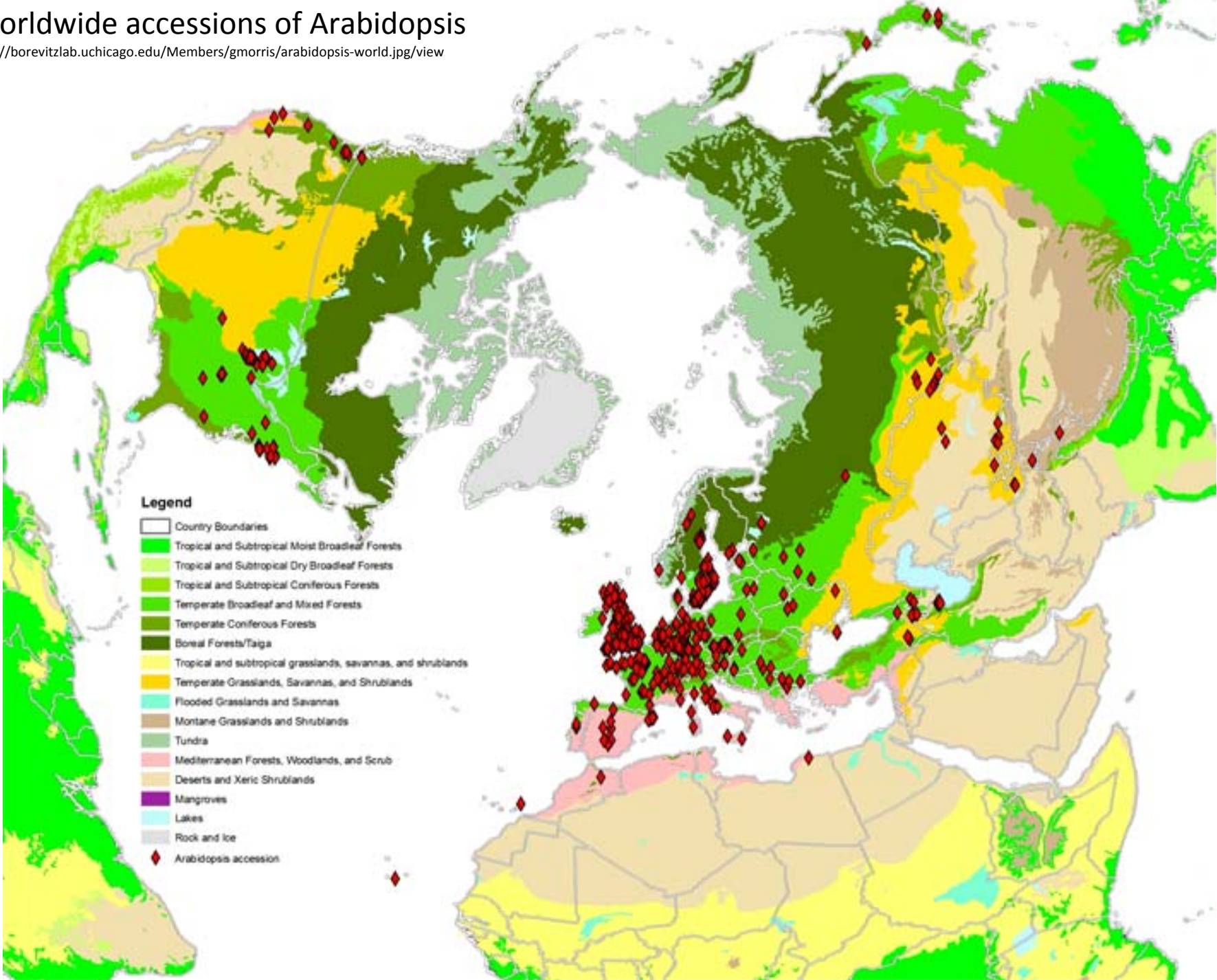
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- Arabidopsis Biological Resource Center (ABRC)
- Nottingham Arabidopsis Stock Center (NASC)
- RIKEN Bioresource Center (BRC)/ SENDAI Arabidopsis Seed Stock Center (SASSC)
  - 300,000 stocks (mutants, insertion/deletion lines, accessions, mapping populations...)
  - Minimal handling fee
  - Requirement for publication (some journals)



# Worldwide accessions of Arabidopsis

<http://borevitzlab.uchicago.edu/Members/gmorris/arabidopsis-world.jpg/view>



# Natural variation in rosette size and architecture

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# Plant genomes may help next generation respond to climate change

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# 1001 Genomes

A Catalog of *Arabidopsis thaliana* Genetic Variation



[Home](#)   [Data Providers](#)   [Accessions](#)   [Tools](#)   [Software](#)   [Data Center](#)   [About](#)   [Help desk](#)

## Welcome to the 1001 Genomes Project

### Check

Track the progress of genome sequencing and availability of *A. thaliana* accessions

[Go >>](#)

### Browse

Select, query and visualize polymorphisms of your favorite loci using *POLYMORPH* and *GBrowse*

[Go >>](#)

### Download

Use the Data Center to download project related SNPs, indels, SVs and genome sequences

[Go >>](#)

### Links

- [> GBrowse](#)
- [> WGS of 80 strains](#)
- [> Assemblies project](#)
- [> POLYMORPH](#)
- [> NCBI SRA Genomes Project](#)
- [> Map resource for 1001 Genomes](#)

### News

**August 1, 2013**

**SHOREmap v2.1** released.

**August 6, 2012**

Nd-1, sequenced by Center for Biotechnology of the University of Bielefeld (CeBiTec), is now available in the [Data Center](#). See the [project page](#) for more information.

**November 29, 2011**

JGI strains Bay-0 and Sha (both TAIR10) are now available in the [Data Center](#). See the [project page](#) for more information.

**November 15, 2011**

JGI strains (Alc-0, Blh-1, Jea, Oy-0, Ri-0 and Sakata) are now available in the [Data Center](#).

**August 28, 2011**

Cao et al. **Whole-genome sequencing of multiple *Arabidopsis thaliana* populations** published in *Nature Genetics*.

## The 1001 Genomes Vision

The 1001 Genomes Project, launched at the beginning of 2008, has as a goal to discover the whole-genome sequence variation in 1001 strains (accessions) of the reference plant *Arabidopsis thaliana*. The resulting information is paving the way for a new era of genetics that identifies alleles underpinning phenotypic diversity across the entire genome and the entire species. Each of the accessions in the 1001 Genomes project is an inbred line with seeds that are freely available from the stock centre to all our colleagues. Unlimited numbers of plants with identical genotype can be grown and phenotyped for each accession, in as many environments as desired, and so the sequence information we collect can be used directly in association studies at biochemical, metabolic, physiological, morphological, and whole plant-fitness levels. The analyses enabled by this project will have broad implications for areas as diverse as evolutionary sciences, plant breeding and human genetics.

The complete genome sequences of over 80 accessions were released in early 2010 by the Max Planck Institute, and many more have been added since by the Salk Institute, the Gregor Mendel Institute and Monsanto. We are on track and for completion of the 1001 Genomes project by the end of 2013. As of June 2013, over 1001 lines have been sequenced and the final set is being analyzed.

Below are the main papers that should be cited for the different datasets:

Ossowski, S., Schneeberger, K., Clark, R.M., Lanz, C., Warthmann, N., and Weigel, D. (2008).

## Accessions

1049 accessions committed as of 4/17/2013.

Regarding the availability of not yet released genomes, please contact the individual **data provider**.

Accession	Alternative ID	Sequenced by	Platform	Actions	Status
11C1	9503	Monsanto/MPI	Illumina	Download data <input type="button" value="Go!"/>	Released
Aa-0	CS6600	Salk	Illumina	Download data <input type="button" value="Go!"/>	Released
Abd-0	CS932	Salk	Illumina	Download data <input type="button" value="Go!"/>	Released
Adam-1	9609	Monsanto/MPI	Illumina	Download data <input type="button" value="Go!"/>	Released
Aedal-1	9321,Ådal-1	GMI	Illumina	Download data <input type="button" value="Go!"/>	Released
Aedal-3	932,Ådal-3	GMI	Illumina	Download data <input type="button" value="Go!"/>	Released
Ag-0	CS22630	Salk	Illumina	Download data <input type="button" value="Go!"/>	Released
Agu-1	CS76409	MPI	Illumina	Download data <input type="button" value="Go!"/>	Released
Aiell-1	9646	Monsanto/MPI	Illumina	Download data <input type="button" value="Go!"/>	Released
Aitba-1	9606	Monsanto/MPI	Illumina	Download data <input type="button" value="Go!"/>	Released
Ak-1	CS6602	Salk	Illumina	Download data <input type="button" value="Go!"/>	Released
Alc-0	INRA Versailles 178AV	JGI	Illumina	Download data <input type="button" value="Go!"/>	Released
Ale-Stenar-44-4	992	GMI	Illumina	Download data <input type="button" value="Go!"/>	Released
Ale-Stenar-56-14	997	GMI	Illumina	Download data <input type="button" value="Go!"/>	Released
Ale-Stenar-64-24	1002	GMI	Illumina	Download data <input type="button" value="Go!"/>	Released
Algutsrum	8230	GMI	Illumina	Download data <input type="button" value="Go!"/>	Released
Alst-1	CS22550	Salk	Illumina	Download data <input type="button" value="Go!"/>	Released
Alt-1	9774	Monsanto/MPI	Illumina	Download data <input type="button" value="Go!"/>	Released
Altai-5	548AV	Salk	Illumina	Download data <input type="button" value="Go!"/>	Released
Amel-1	CS22526	Salk	Illumina	Download data <input type="button" value="Go!"/>	Released
An-1	CS22626	Salk	Illumina	Download data <input type="button" value="Go!"/>	Released
Ang-0	CS6605	Salk	Illumina	Download data <input type="button" value="Go!"/>	Released
Anholt-1	CS22313	Salk	Illumina	Download data <input type="button" value="Go!"/>	Released

Search

Display

Tracks

- Ame1\_1.SALK
- An\_1.SALK
- Ang\_0.SALK
- Anholt\_1.SALK
- Ann\_1.SALK
- Anz\_0.SALK
- App1-12.GMI
- App1-14.GMI
- App1-16.GMI
- Appt\_1.SALK
- B-B
- C-C
- C24.MPI
- CATS-6.9937.M
- CHA-41.932.M
- CIBC\_17.SALK
- CIBC\_5.SALK
- CON-7.9913.M
- CSHL-5.6744.M
- CYR.88.MON-N

Bookmarks

Options

Information

Credits

Arabidopsis 1,001 Genomes chr4 : 17679497 - 17684496 (TAIR10)

At4g37630

At4g37630

Col-0.MPI

Kas\_1.SALK | A

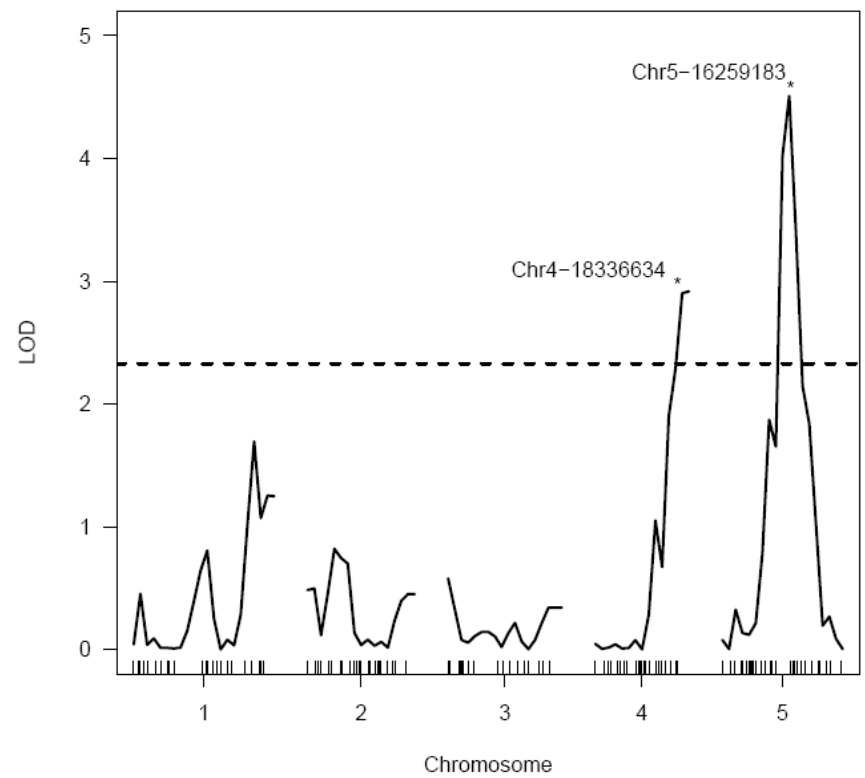
Kas\_2.SALK | A

Ler-1.MPI

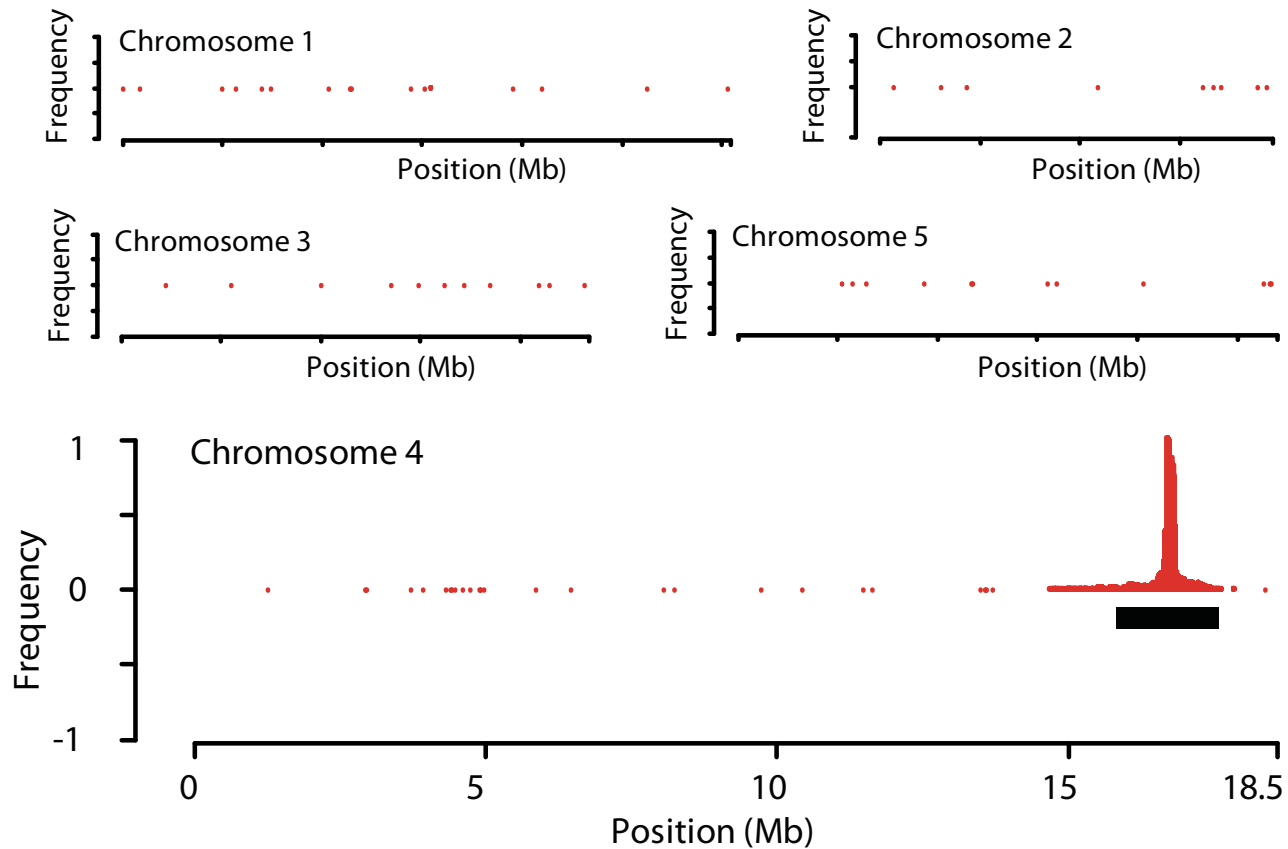
An\_1.SALK

17681877

At4g37640

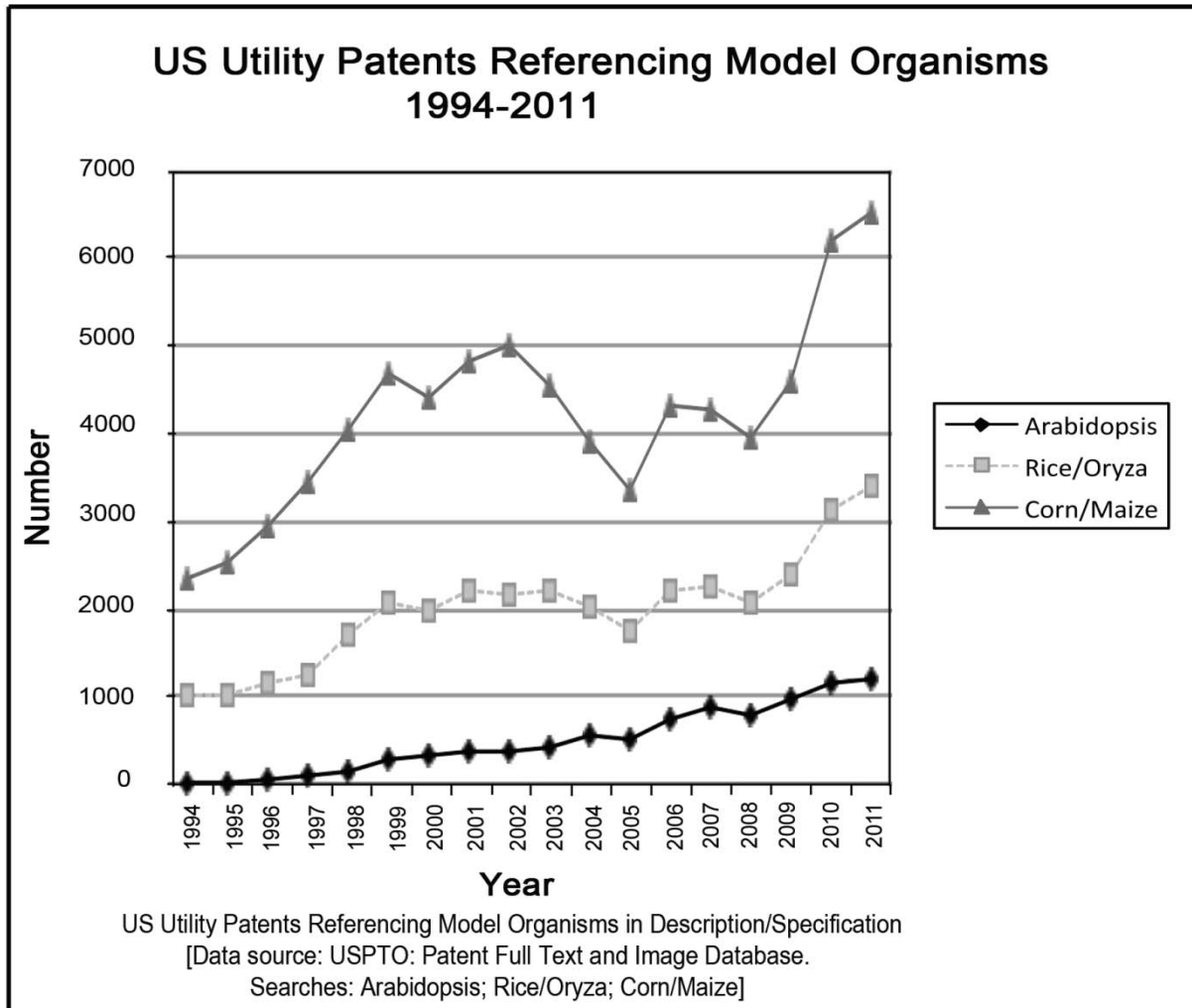


# Mapping induced mutations in ~ 1 week



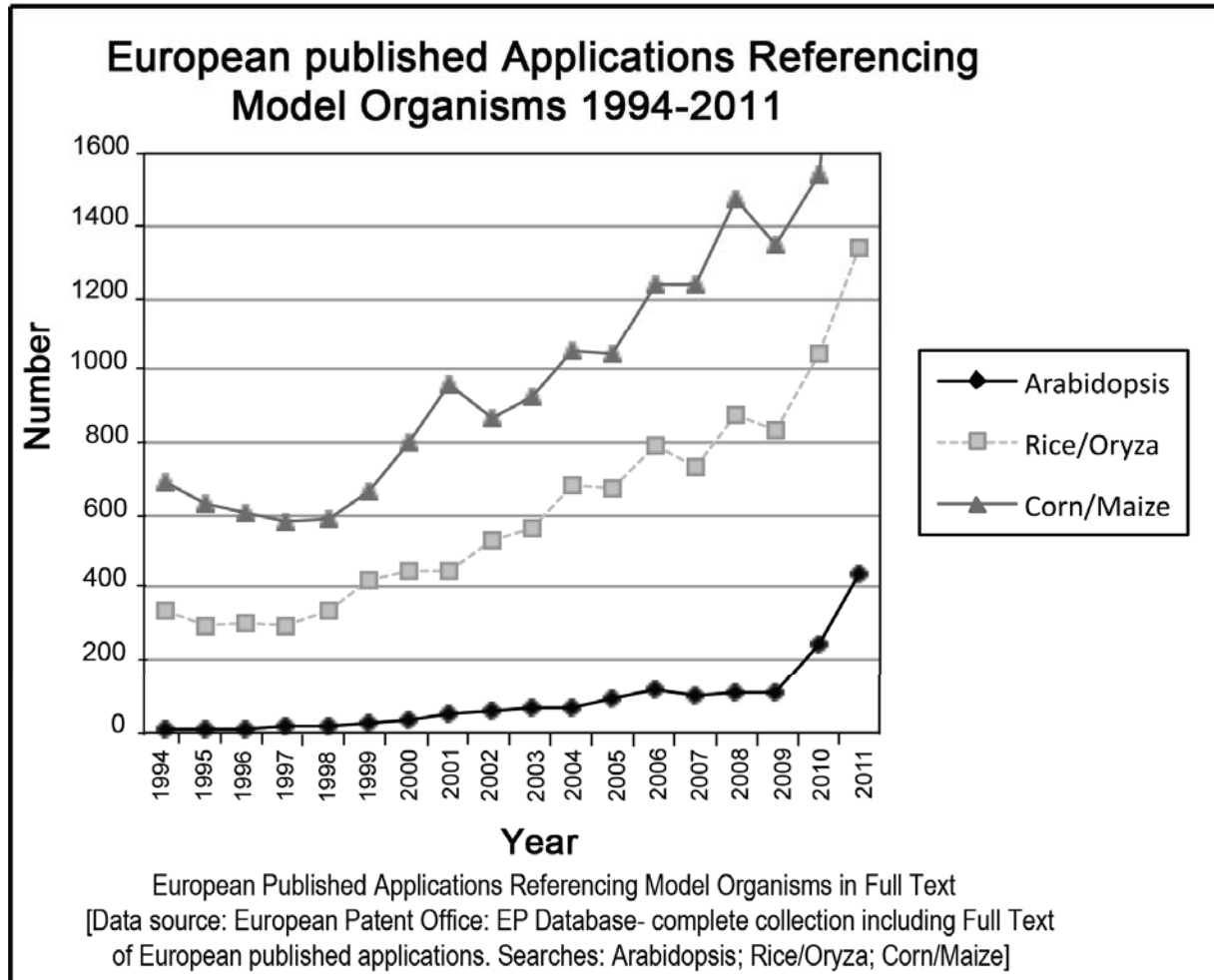
Sliding window of 200 kb

# Translational research





# Translational research





# Road Map for the next 10 year

---

- Build a predictive model of an Arabidopsis plant from its molecular parts.
- Build the international Arabidopsis Informatics consortium, an international informatics and data infrastructure
- Exploit the wealth of natural variation that exists in Arabidopsis to further our understanding of Adaptation and evolution
- Establish an effective knowledge exchange pipeline from the laboratory to the field and vice versa

# Artemia salina

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Small, short generation cycle, but a large genome (1.6Gb),...

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# Road Map for the next 10 year

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# Importance of Model Systems

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By focusing on one model system many novel findings for Plant Biology were made:

- Plant hormone receptors and MOA
- Flower induction mechanism (florigen)
- Small RNAs



# Multinational Arabidopsis Steering Committee

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MASC

Yearly reporting

Continental subcommittees