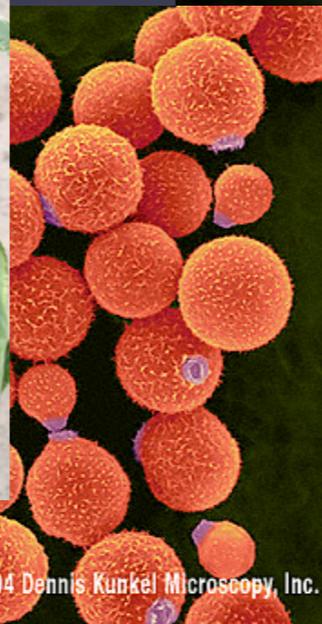


# Microbial host interactions: a double-edge sword

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# Wonderful diversity of fungi



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# What is mycorrhiza?

Symbiosis between  
plant roots and the  
fungus



# Evolution of mycorrhiza

**400 miljoner år sedan**

den första landväxten med svamp på rötterna

**250 miljoner år sedan**

kottepalm med kraftig mykorrhiza och samarbete med kvävelixerande cyanobakterier

**100 miljoner år sedan**

barrträd bildar ektomykorrhiza med hattsvamp

**360 miljoner år sedan**

ornbunksträd med mykorrhiza

**60 miljoner år sedan**

ljungväxter bildar ektomykorrhiza med skålsvamp

**knappt 10 miljoner år sedan**

orkidéer bildar ektomykorrhiza med röttsvamp

# From 1 to 1000 genomes



nature

LETTERS

## The genome of *Laccaria bicolor* provides insights into mycorrhizal symbiosis

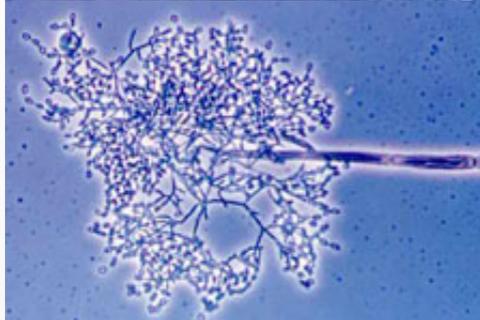
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# 5 symbiotic genomes



Ascomycota; Pezizomycotina;  
Pezizomycetes; *Tuber*

Tubme1



Ascomycota; Pezizomycotina;  
Leotiomyces; *Oidiodendron*

Oidma1



Basidiomycota; Agaricomycotina;  
Agaricomycetes; Boletales; *Paxillus*

Paxin1



Basidiomycota; Agaricomycotina;  
Agaricomycetes; Agaricales; *Hebeloma*

Hebcy1



Basidiomycota; Agaricomycotina;  
Agaricomycetes; Agaricales; *Laccaria*

Lacbi2

# Armed and Dangerous

These fungi, weeds, and viruses are among the more serious biological threats to food security—so researchers are working hard on countermeasures

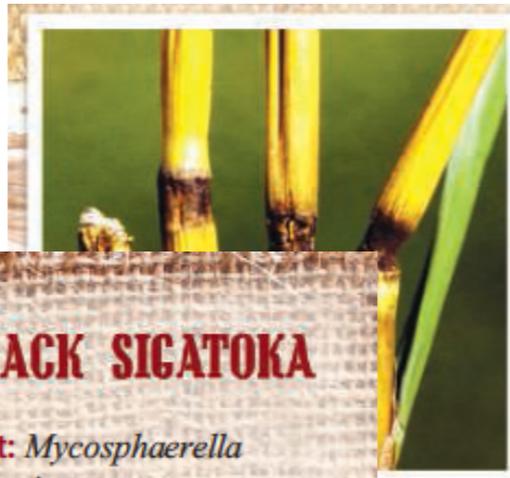
## BIG 7



### POTATO BLIGHT

**Pest:** *Phytophthora infestans*

**Crops:** Potatoes; also tomatoes and other solanaceous crops



### RICE BLAST

**Pest:** *Magnaporthe oryzae*

**Crops:** Rice, 50 species of grasses and sedges



### BLACK SIGATOKA

**Pest:** *Mycosphaerella fijiensis*

**Crops:** Bananas, plantains

**Whereabouts:** This fungus, first detected in Fiji in 1964, is now found in 100 countries in the Americas, Africa and South Asia.



### ASIAN SOYBEAN RUST

**Pest:** *Phakopsora pachyrhizi*

**Crops:** At least 31 legume species, notably soybeans



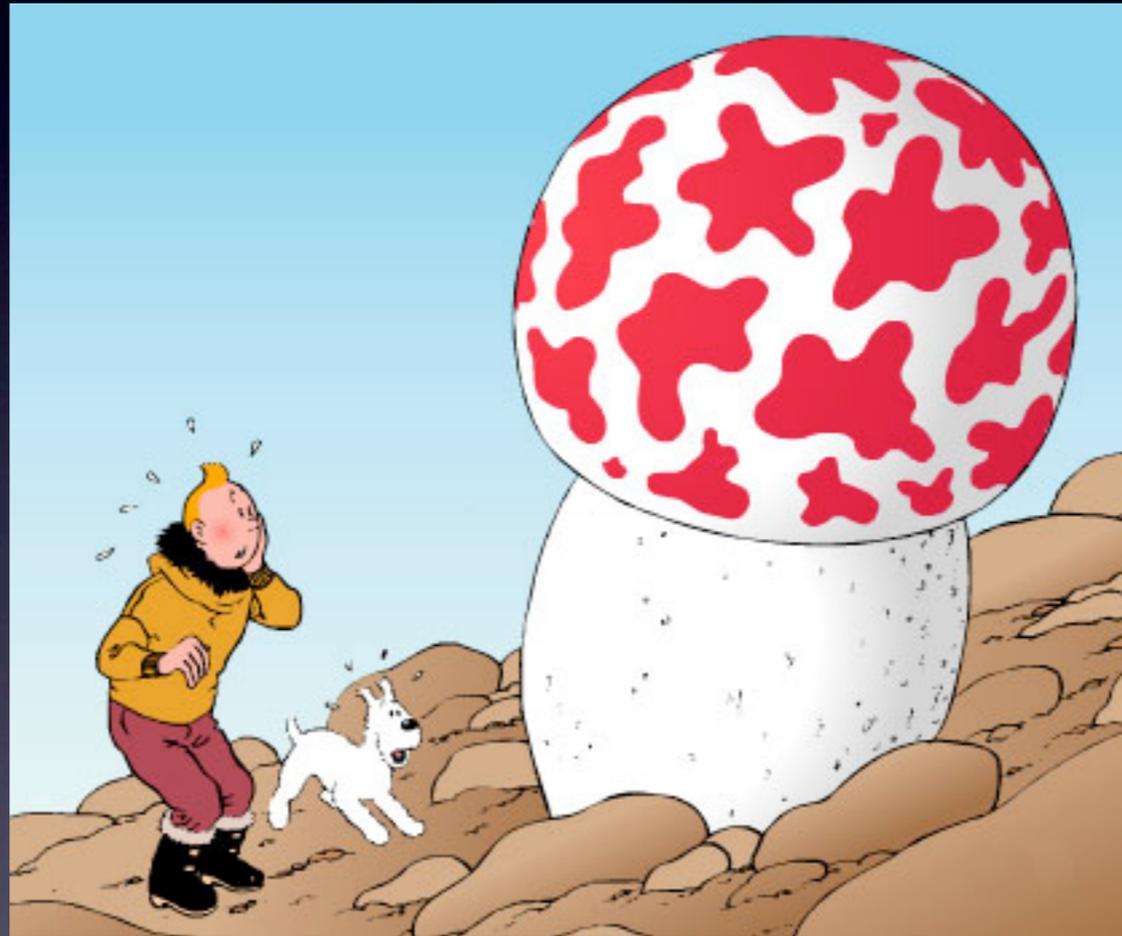
### WHEAT STEM RUST

**Pest:** *Puccinia graminis* Ug99

**Crop:** Wheat

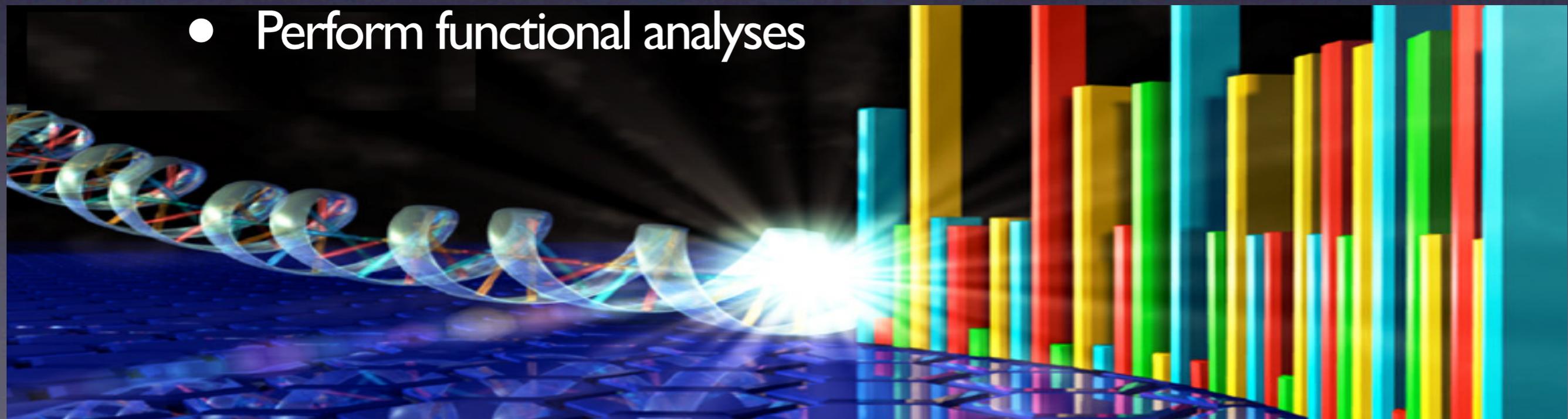
12 FEBRUARY 2010 VOL 327 SCIENCE

# Use genomics to understand microbe-host interactions



# Genome sequencing

- Extract DNA from the organism
- Fragment and sequence the DNA (millions of pieces)
- Assemble the sequences to a genome
- Find genes in the genome
- Perform functional analyses

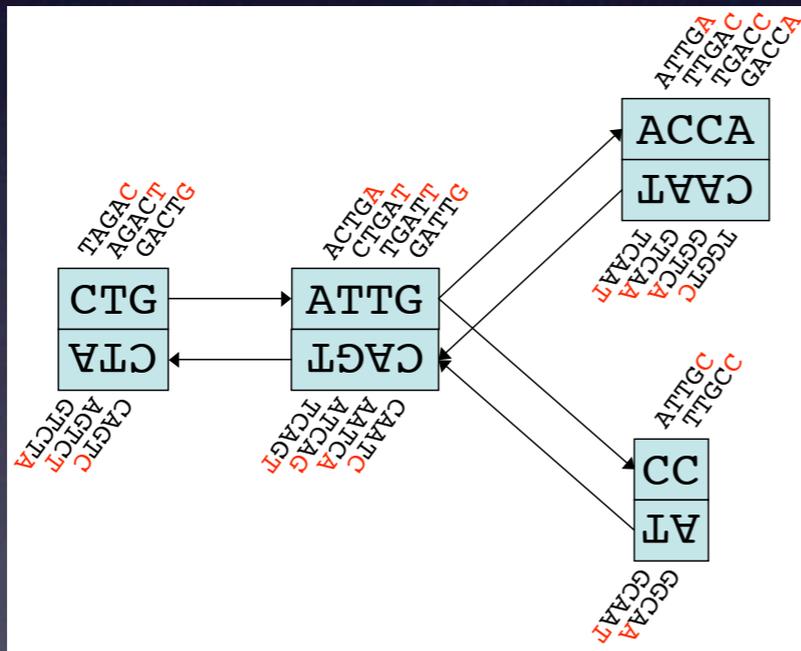


# Computational challenges

- Rapidly moving field requires novel tools and algorithms
- Data analyses, transfer and storage
- Bioinformaticians

# Assembly

- Overlap Consensus Layout OLC
- De Bruijn Graphs



# Sequencing technologies



Roche / 454  
GS FLX Titanium Series  
1,2 million reads  
Read length approx. 400 bp  
400 million bp per run



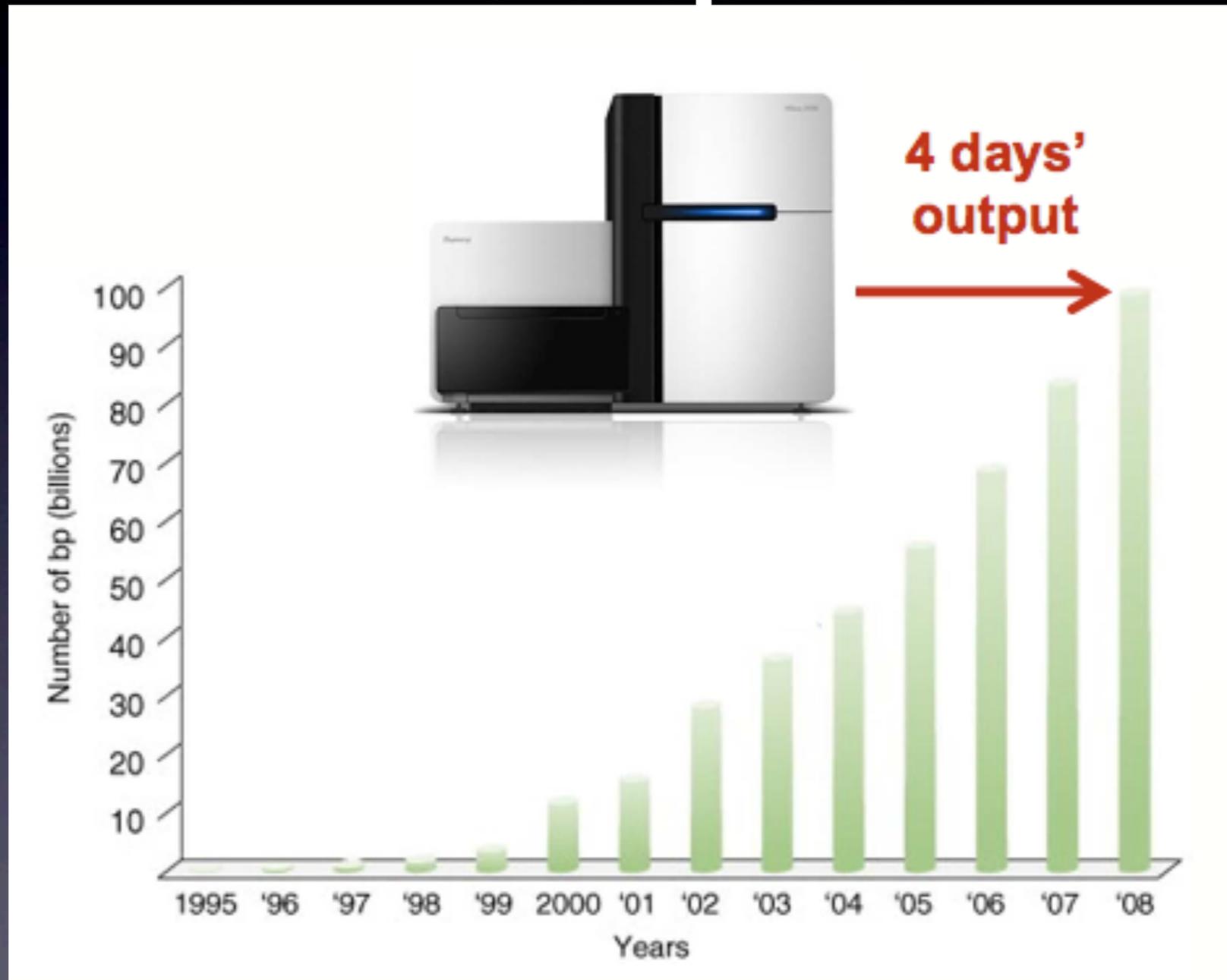
Applied BioSystems (ABI)  
3730xl DNA Analyzer (Sanger)  
96 samples in parallel (reads)  
Read length approx. 800 bp  
- 80.000 bp per run

Illumina / Solexa  
HiSeq 2000  
- >2 billion reads  
- Read length approx. 70 bp  
- 200 Gbp per run

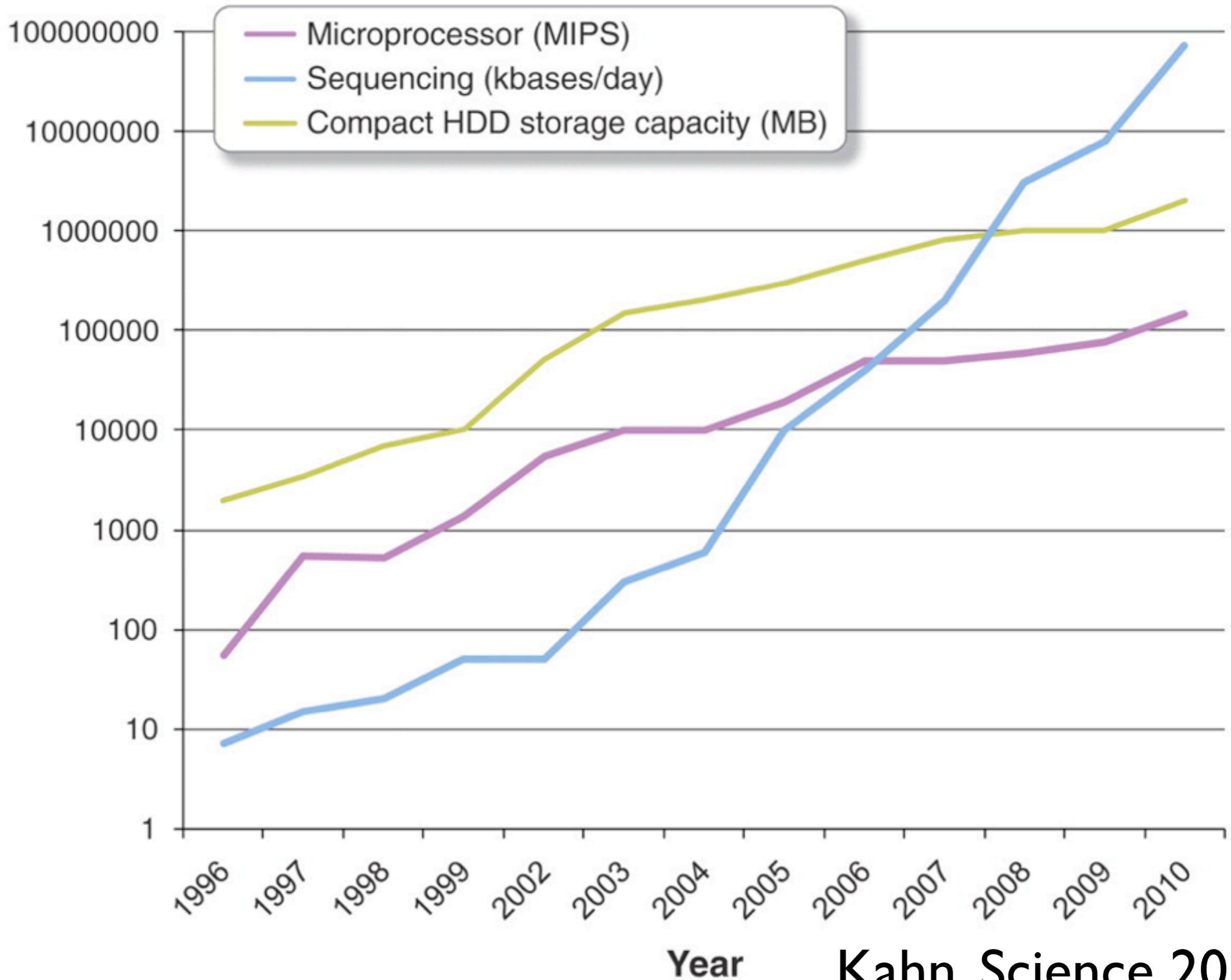


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# Cumulative sequence output



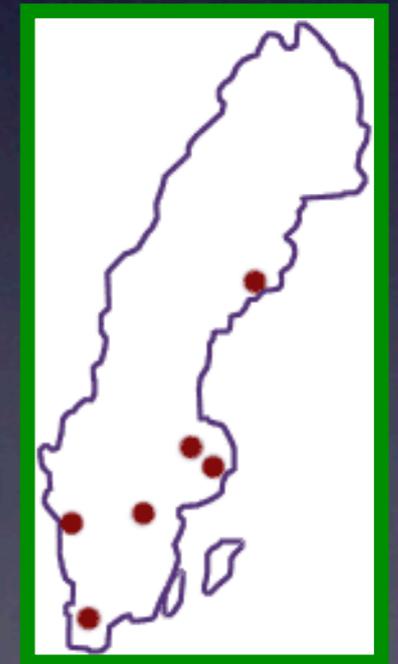
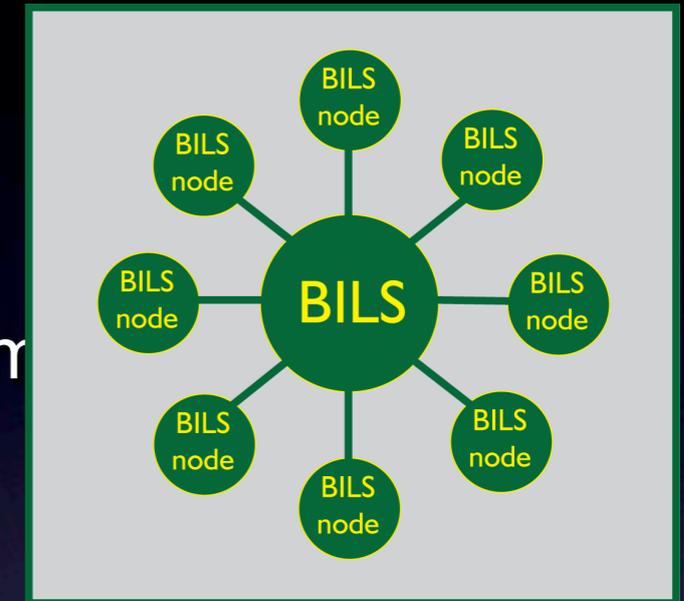
Rokas presentation Workshop in Genomics 2012



Kahn, Science 2011

# BILS — Bioinformatics Infrastructure for Life Sciences

- Distributed national research infrastructure supported by the Swedish Research Council
- BILS provides bioinformatics support in various projects, e.g. in large-scale sequencing, proteomics, systems biology, metabolomics, metagenomics
- BILS provides infrastructure and tools for bioinformatics analyses
- Bioinformatics network
  - nodes at each of the 6 large university cities
  - annual workshop
  - training
- Bioinformatics computation and data storage provided in collaboration with SNIC
- Swedish node in ELIXIR
- Current staff of 11 people – will during 2012 expand to 26 persons



# Acknowledgements

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