Physical Map and Organization of Arabidopsis thaliana Chromosome 4

R. Schmidt et al.
Arabidopsis seedling 1 week old
Arabidopsis plants 2.5 weeks old
Arabidopsis Shoot

http://www.weigelworld.org/research/gallery/arabidopsis/view
Arabidopsis plant 3 weeks old

http://www.mpimp-golm.mpg.de/arabidopsis/thaliana-e.html
Arabidopsis and tobacco shoots
3 weeks old
Arabidopsis plant, 4 weeks old
Arabidopsis siliquae with 30 – 40 seeds

http://transplant.sinica.edu.tw/english/photo/tech/c/1.htm
Thousands of Arabidopsis seeds can be placed on a petri dish.

seeds

seedlings
Corn kernals on a petrie dish
Corn germinating
Arabidopsis harvest
Physical Map of the Arabidopsis Genome

What is a physical map?

Why make a physical map?

<table>
<thead>
<tr>
<th>Chromosome organization/structure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compare genetic, cytogenetic with physical</td>
</tr>
<tr>
<td>Use to guide sequencing of the genome</td>
</tr>
<tr>
<td>Examine distribution of repeated sequences</td>
</tr>
</tbody>
</table>
YAC cloning vector

- 200 kb genomic fragment
- Cloning site
- Restriction site
- Yeast telomere
- Yeast centromere
- Bacterial origin of replication
- Bacterial selectable marker
- Yeast telomere
Defining Clone Contigs

- Chromosome 4 segment

0.8 cM 0.6 cM 1.9 cM 0.6 cM

CAPS 16 CAPS 41 CAPS 4 CAPS 83 CAPS 27

300 kb 600 kb
Aligning YAC/BAC clones

= EcoR1 site
Defining Clone Contigs

- Chromosome 4 segment

[Diagram showing CAPS markers 16, 41, 4, 83, and 27 along a chromosome segment]
YAC cloning vector

200 kb genomic fragment

Cloning site

Bacterial origin of replication

Bacterial selectable marker

Yeast centromere

Yeast telomere

Restriction site
YAC end cloning

restrict

ligate

IPCR

Plasmid Rescue

primers

amplify

ori

marker

Transform E. coli
Defining Clone Contigs

- Chromosome 4 segment

Rflp 16  Rflp 41  Rflp 4  Rflp 83  Rflp 27
Physical Map of the Arabidopsis Genome

What is a physical map?

Why make a physical map?

How does a physical map differ from a genetic map?
Figure 1. The alignment of cytogenetic, YAC contig and RFLP maps of chromosome 4.
Figure 2. Distribution of recombination hot spots on chromosome 4
Figure 1. The alignment of cytogenetic, YAC contig and RFLP maps of chromosome 4
The nucleolus is the site of ribosome synthesis from the rRNA genes.
Figure 1. The alignment of cytogenetic, YAC contig and RFLP maps of chromosome 4.
The centromere is the site of closest attachment of sister chromatids

http://www.salem.k12.va.us/staff/jwright/vocabulary/centromere.html
Figure 3. Contig covering the centromeric region
Figure 1. The alignment of cytogenetic, YAC contig and RFLP maps of chromosome 4.
Figure 2. Distribution of recombination hot spots and nine families of repetitive elements on chromosome 4.
Conclusions

1. A physical map of Arabidopsis chromosome 4, consisting of 4 contigs, has been constructed starting with a genetic RFLP map.

2. The size of the chromosome was estimated to be 17+4.5 Mb (21.5 Mb after sequencing).

3. Recombination hotspots and cold spots are distributed throughout the chromosome with cold spots at both the NOR and centromere.

4. The NOR and centromere were localized to the genetic and physical maps using repetitive element probes specific to those chromosomal structures.

5. Repetitive sequences were clustered in the centromeric region.