MATING TYPE AND SPECIES RECOGNITION IN THE ASPERGILLI

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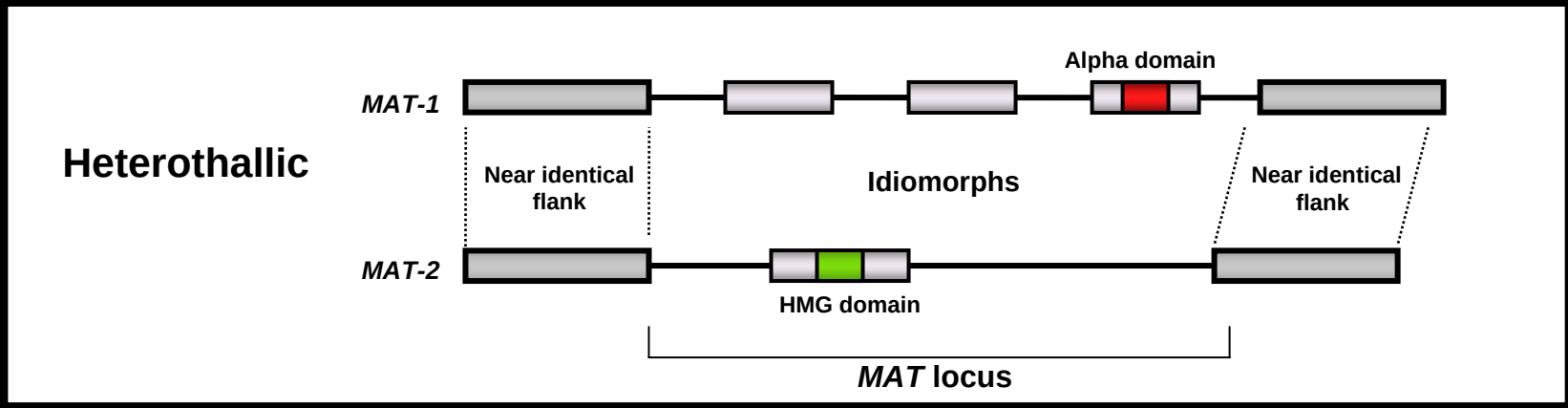
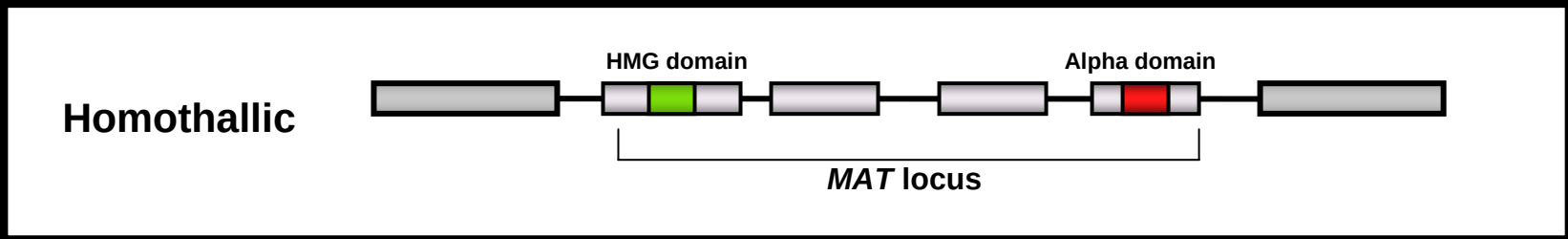
Beginners Guide to Sex… and Mating-Type (*MAT*) Genes

Homothallism - single isolate self fertile

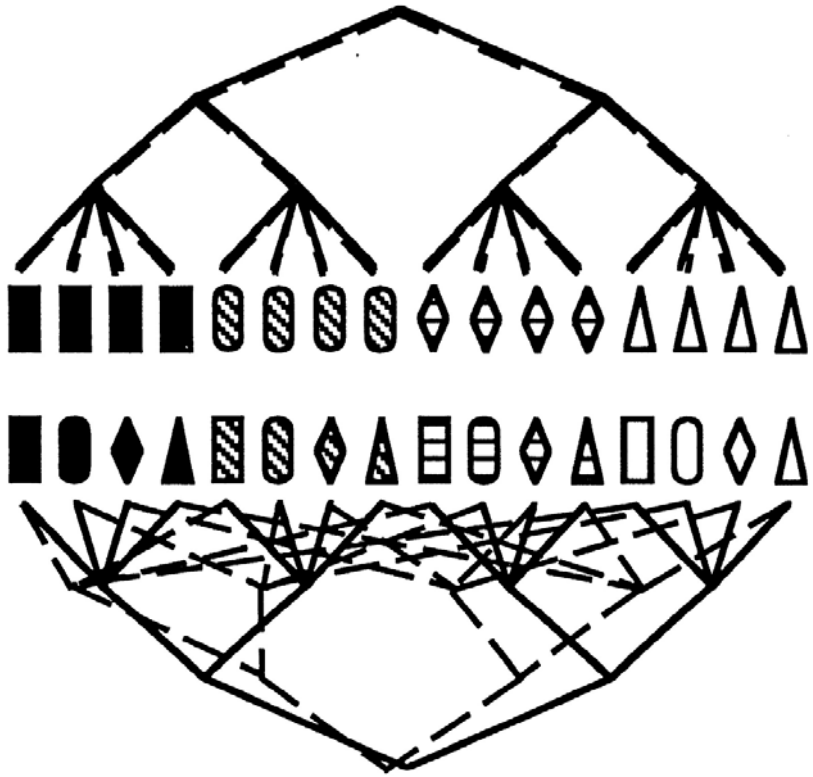
Heterothallism - different partners of complementary mating-type required for sex





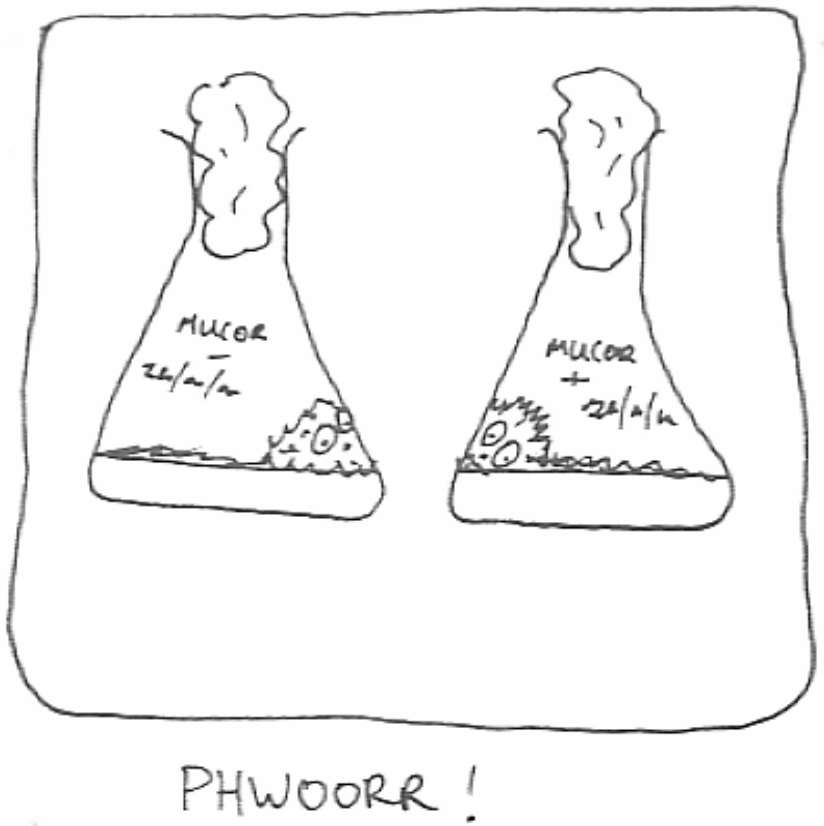
SEXUAL REPRODUCTION AND SPECIES RECOGNITION

CLONAL - ASEXUAL

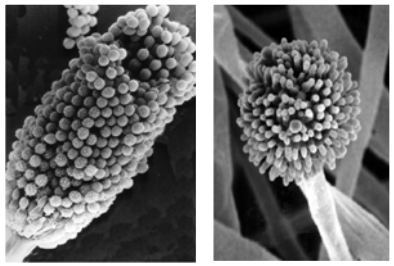


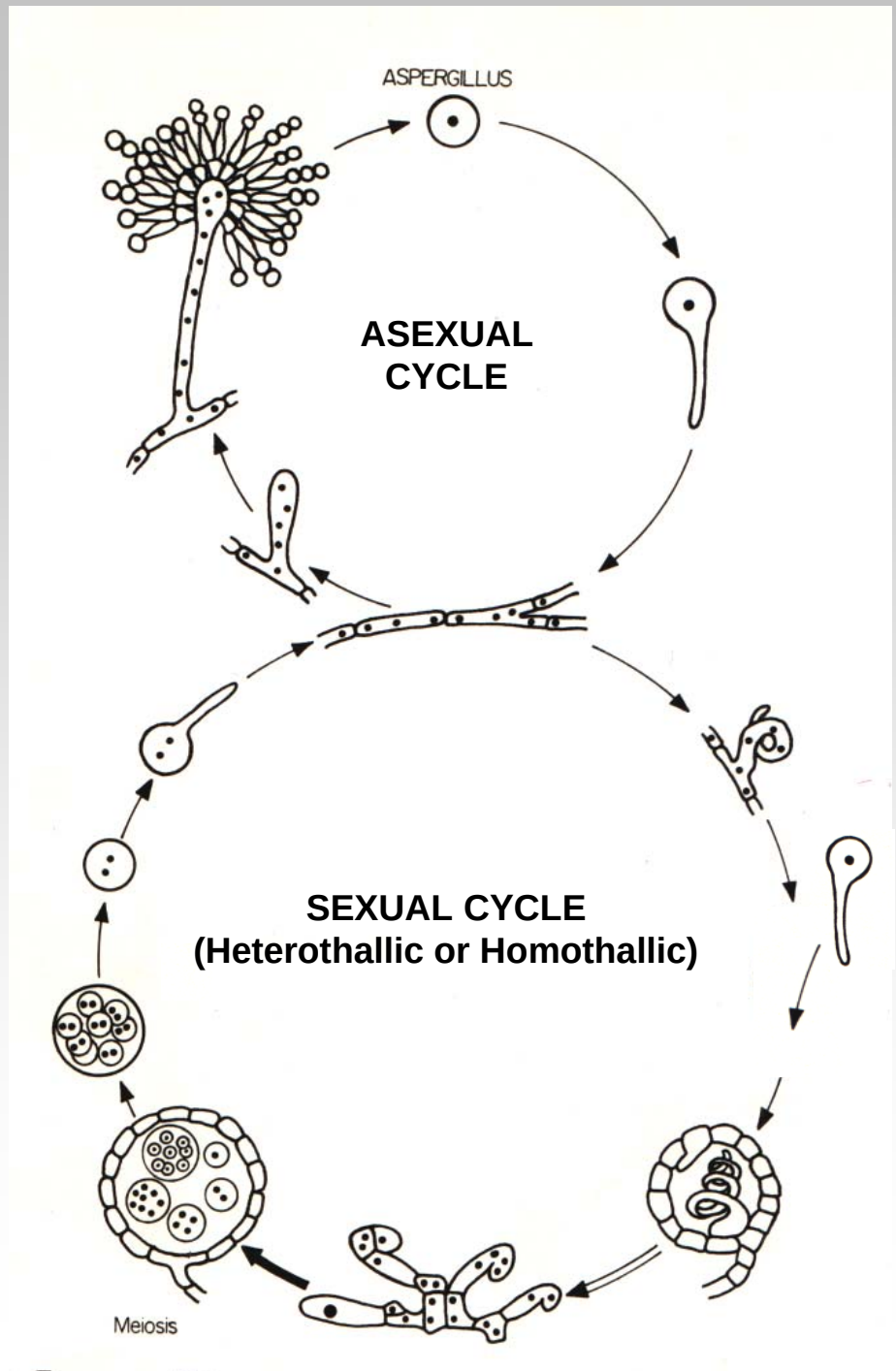
RECOMBINING - SEXUAL

Taylor, Geiser, Burt, Koufopanou (1999)
Clinical Microbiol Rev **12**: 126-146



Biological Species Concept (BSC)
with Sexual Compatibility



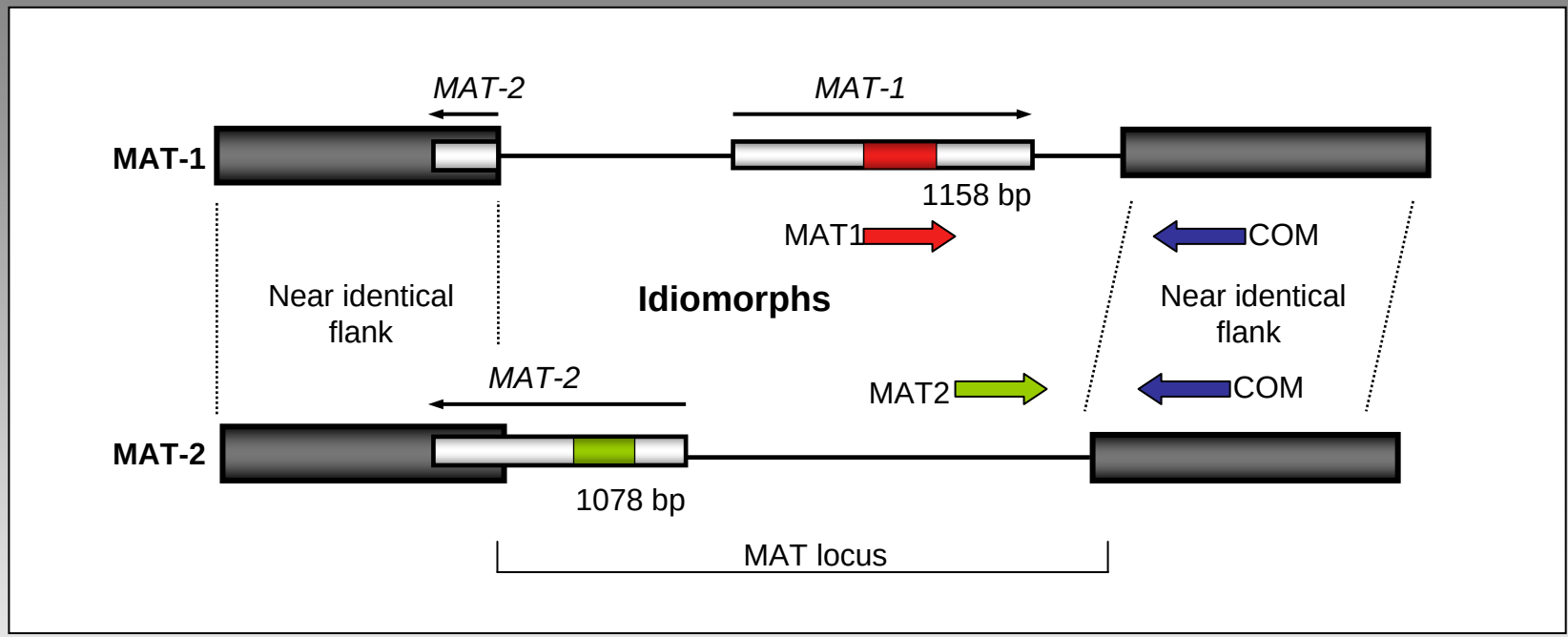


c. 70 sexual species, only 4 heterothallic. Obstacle to Biological Species Concept

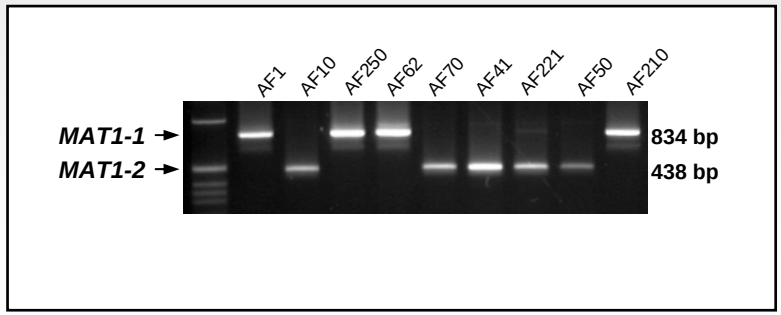
(1) MATING-TYPE, SEXUALITY AND GENE FLOW

- Can *MAT* genes give clues to possible sexuality in 'asexual' species, with possible application of biological species concept?
- Can *MAT* genes give indication of gene flow/ recombination in 'asexual' populations i.e. united species?

(a) *Aspergillus fumigatus*



PCR-based mating-type diagnostic test:



A. fumigatus

290 worldwide isolates

Europe, Africa, Asia,
North and South America,
and Australasia

(Data clone corrected)

Table 1. Distribution of *MAT1-1* and *MAT1-2* idiomorphs (mating type) amongst a worldwide collection of clinical and environmental isolates of *Aspergillus fumigatus*.

Sample source	Mating-type frequency[*]		$\chi^{2\dagger}$	
	MAT1-1	*MAT1-2*		
Clinical	40.8 (40)	59.2 (58)	3.31 (1)	
(clone corr.)[‡]	40.7 (33)	59.3 (48)	2.78 (1)	
Environmental	44.8 (73)	55.2 (90)	1.77 (1)	0.39[§] (1)
(clone corr.)[‡]	44.7 (71)	55.3 (88)	1.82 (1)	0.33[§] (1)
Total	43.3 (113)	56.7 (148)	4.69[¶] (1)	
(clone corr.)[‡]	43.3 (104)	56.7 (136)	4.27[¶] (1)	

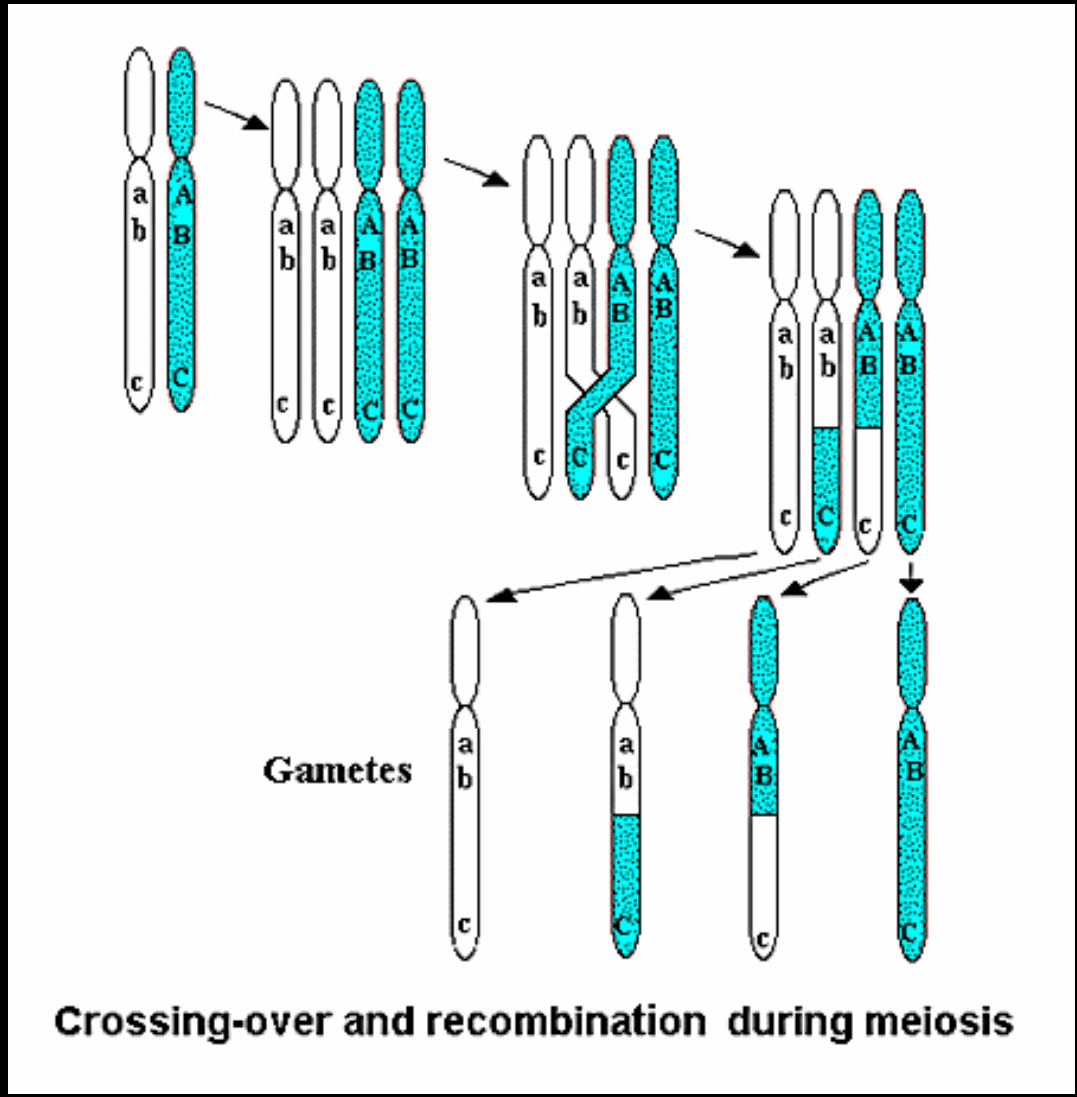
[*]Numbers in parentheses refer to number of isolates.
[†]Number in parentheses indicates degrees of freedom.
[‡]Clone corrected data. [§]Contingency χ^2 value.
[¶]Significant at $P = 0.05$.

SUMMARY:
43% *MAT-1*; 57% *MAT-2*

Consistent with sexually reproducing species

Current Biology (2005) **15**: 1242-1248

MAT and Population Genetic Analyses - Gene Flow and Speciation?



106 worldwide *A. fumigatus* isolates including Canadian, German, American subpopulations.
Three intergenic non-coding regions *inter1* - *inter3*

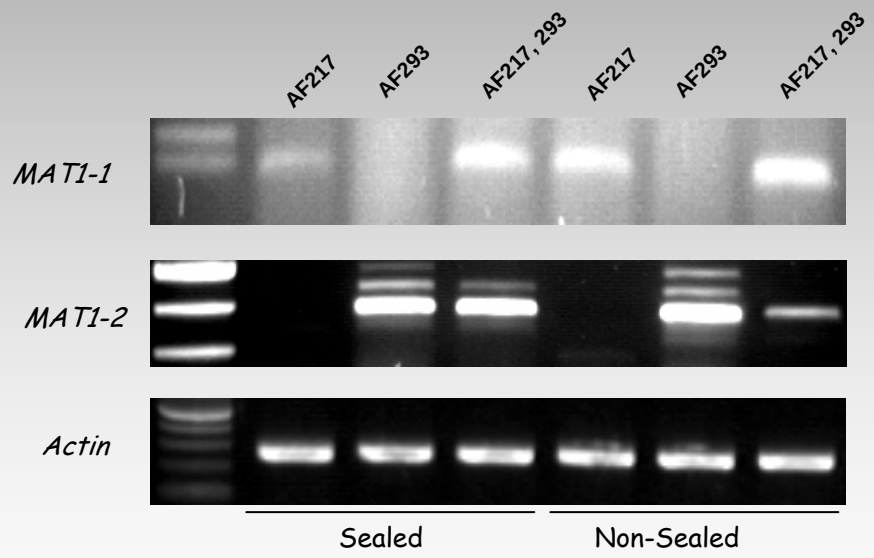
(a) 9 of 24 total polymorphisms shared between *MAT-1* and *MAT-2* pools
(b) Index of association shows no significant association between three most balanced polymorphisms

Evidence of recombination;
Consistent with sexually reproducing species

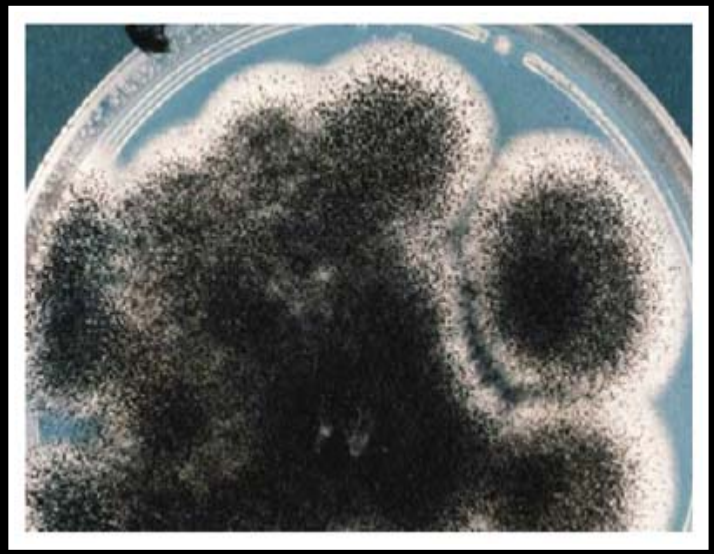
Current Biology (2005) **15**: 1242-1248

Aspergillus fumigatus

RT-PCR to assess gene expression



(b) *Aspergillus niger* and Black Aspergilli



Co-investigators: Janos Varga, Scott Baker, Rob Samson, Karoly Pál, Fons Debets, S Kocsube, G Eyres, L Lane

Genome sequence isolates *A. niger* are both *MAT-1* alpha

Screen c.200 isolates black Aspergilli with *Aspergillus MAT-1* and *MAT-2* degenerate PCR primers

c. 87% of group are *MAT-1* alpha genotype. e.g. 86/94 *A. niger*, 51/65 *A. tubingensis*, 5/5 *A. carbonarius*
RT-PCR/microarray studies - no expression *A. niger?*

Evidence for truly asexual lineage,
Clonal considerations for speciation?

(2) USE OF *MAT* GENES AS SPECIES MARKERS

- *MAT* genes found to be fast evolving - therefore is sequence of use as phylogenetic marker to distinguish species?
- Have degenerate *MAT1* and *MAT2* primer set
- Problem of either *MAT1* or *MAT2* gene issue

SUMMARY - Mating Type and Speciation

- Mating-type distribution can give insights into possible sexuality
- Mating type can be used as a marker of gene flow/recombination in populations
- Mating-type genes are highly divergent so may provide useful species-specific markers