HETEROTHALLISM

BSc. BOTANY

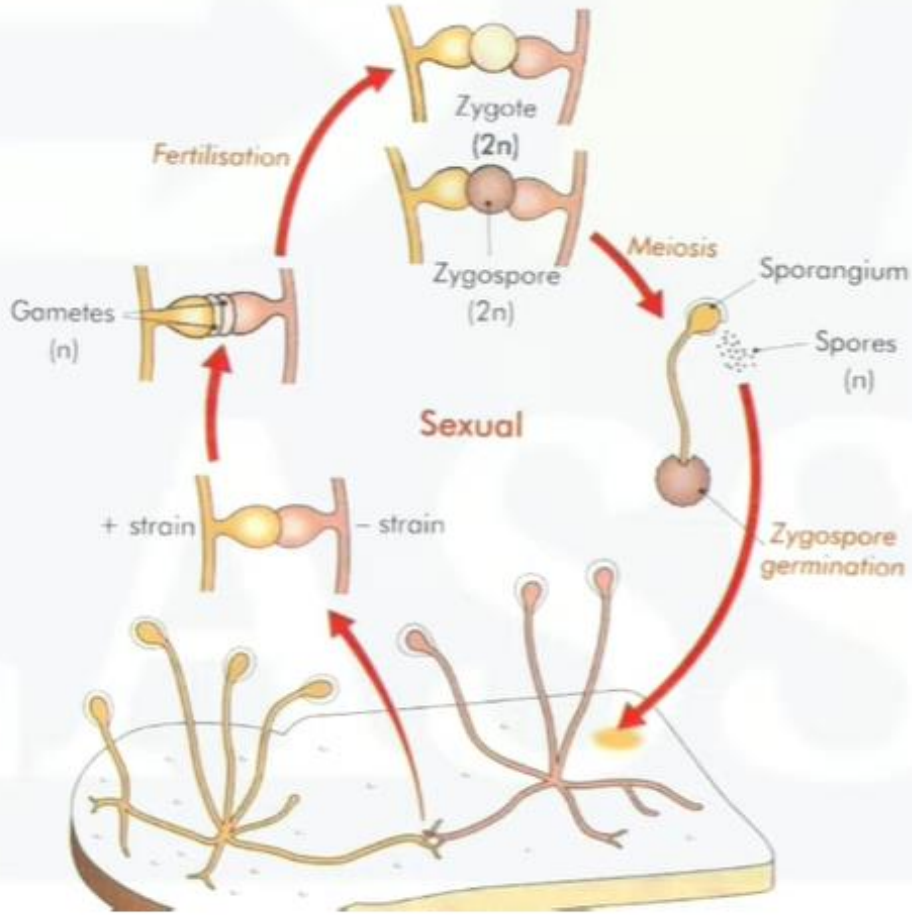
Heterothallism

- The term Heterothallism was first used by an American geneticist A.F. Blakeslee in 1904

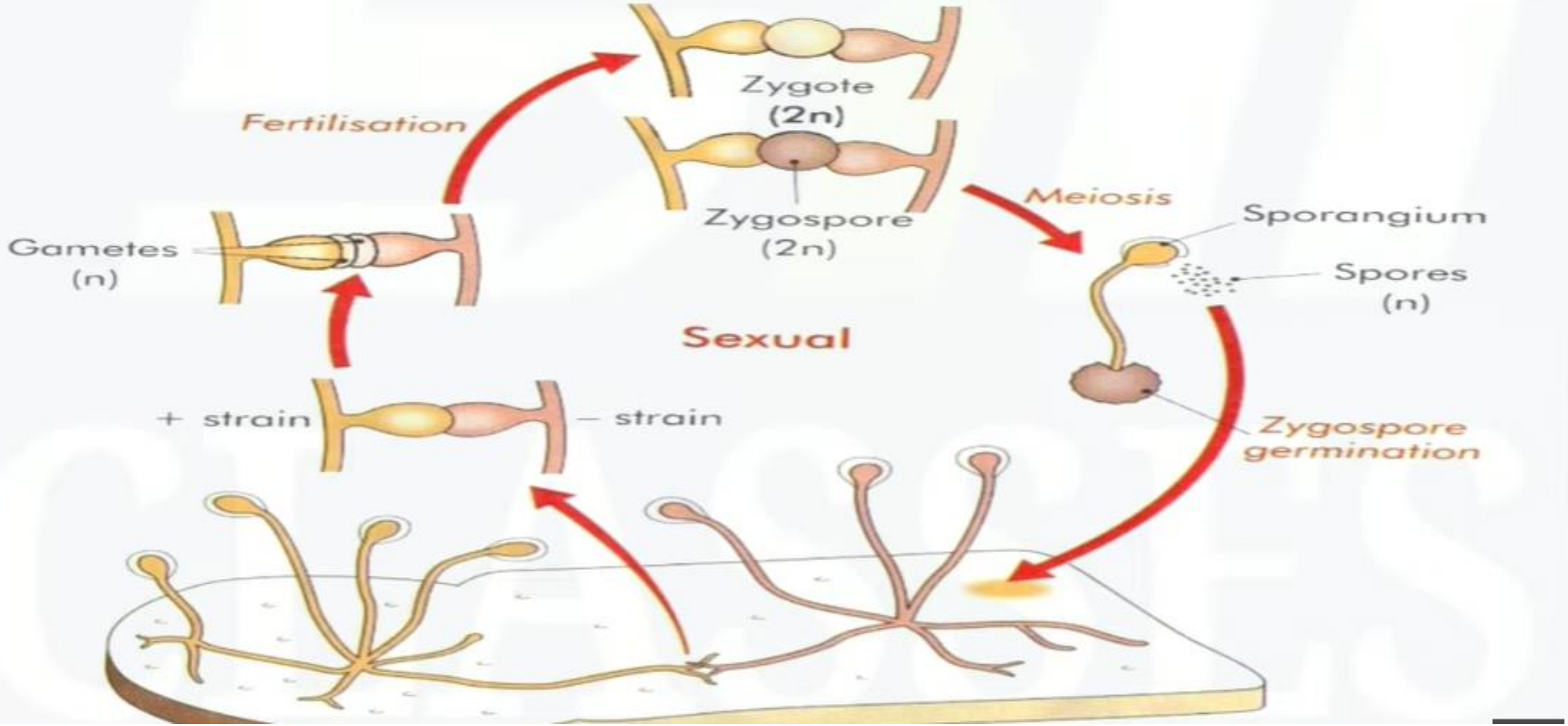
- This is a condition of sexual reproduction in certain species of Mucorales

- It was observed that in some species of Rhizopus, only when two mycelia of different strains were allowed to come in contact with each other they developed into a Zygospore

Heterothallism may therefore be defined as the condition in which Zygospore formation takes place only when mycelia arising from asexual spores of two genetically different mating types (+) and (-), are allowed to interact.



Sexual reproduction in Rhizopus



Homothallic	Heterothallic
➢ The homothallic species are those which require mycelia of only one strain to interact for the formation of Zygospores ➢ The mycelium is bisexual	➢ The heterothallic species require mycelia of two different strains to interact to enable the zygospores to be formed ➢ The mycelium is unisexual, (+) and (-) strains represent the two different sexes

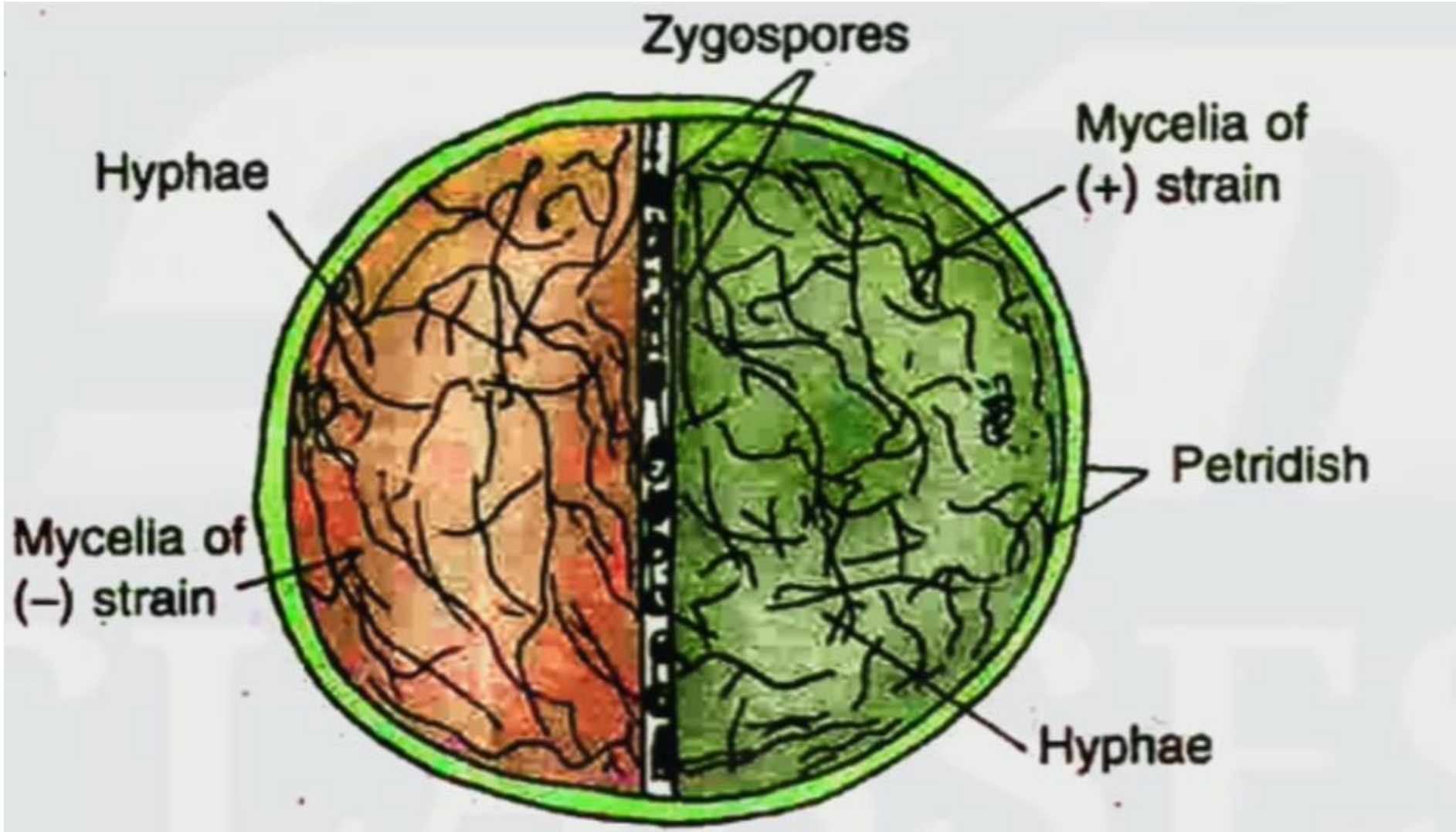


Fig. 17.2 *Mucor hiemalis*. Zygospore formation indicating Heterothallism.

The phenomenon of heterothallism was first reported order Mucorales, but now this has been established in Rusts, smuts, members of Homobasidiomycetidae and other fungi •


Heterothallism
Morphological
Physiological

1. Morphological heterothallism:

- Morphological heterothallism may be defined as the condition when morphologically different sex organs are produced in two closely associated mycelia
- The two sex organs or gametes are morphologically different that it is easier to term one of them as male and the other as female

Ex. Achlya ambisexualis, A. bisexualis, Blastocladiella variabilis, Dictyuchus monosporus, Phytophthora palmivora and Peronospora parasitica

2. Physiological heterothallism This means that sexual reproduction takes place by two morphologically similar but physiologically different hyphae in physiological heterothallism.

Physiological heterothallism may be of two types:

(i) Two-Allele Heterothallism:

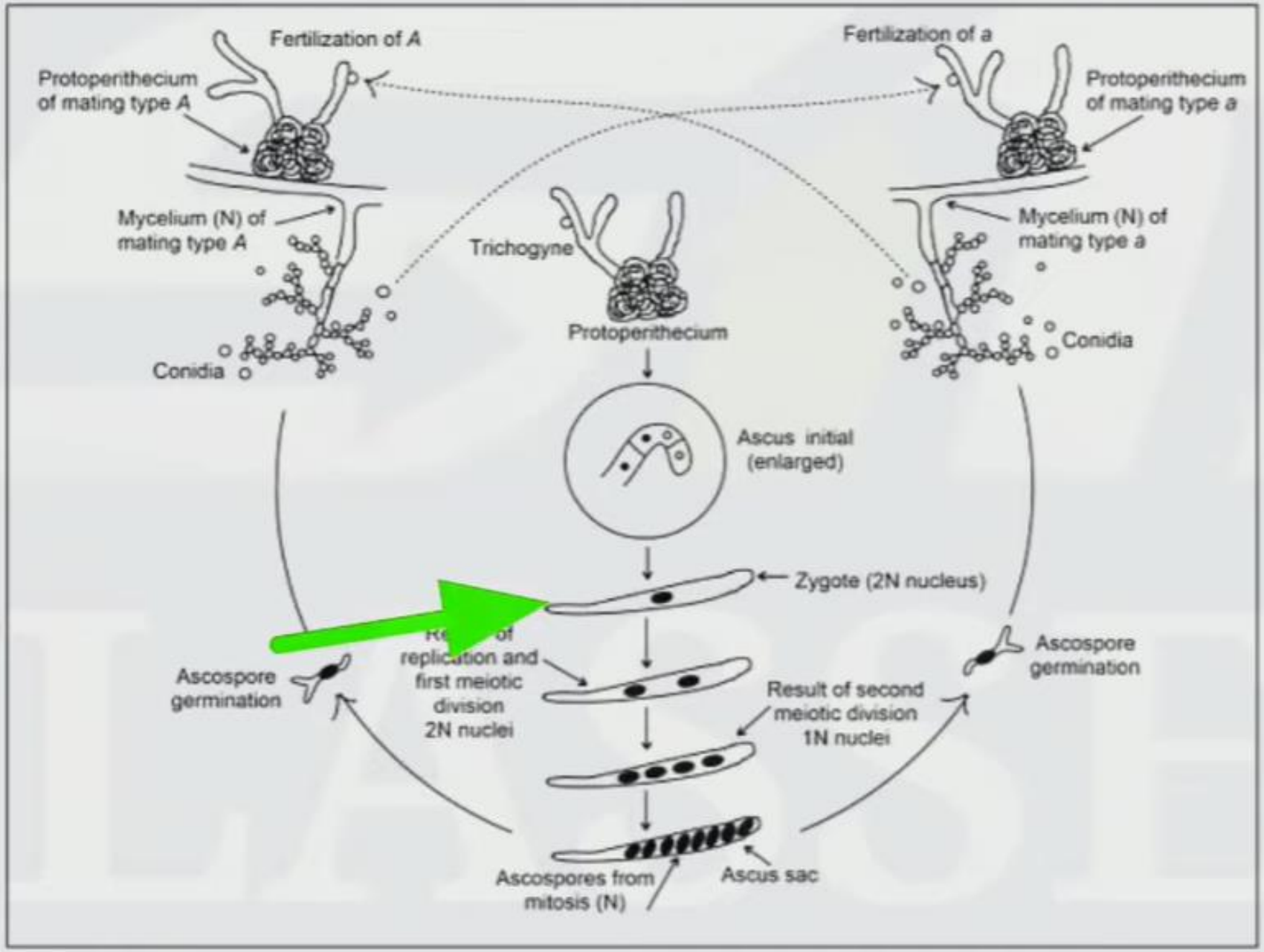
(ii) Multiple Allele Heterothallism:

(i) Two Allelomorphs or Two-Allele Heterothallism:

When nuclei of both the mating types are different in genetic characters, this type of Heterothallism is known as Two-Allele heterothallism. In these types compatibility is governed by a pair of Alleles represented by A and a located at single same locus of the chromosome.

- **The allele A is dominated and represented by (+) and a by (-)**
- **The spores bearing (+) allele will produce (+) mycelia and the spores with (-) allele will give rise to (-) mycelia.**
- **The mycelia of (+) and (+), and (-) and (-) are self-sterile or self-incompatible**

Ex. *Ascobolus magnificus, Puccinia graminis, Neurospora sitophila Mu mucedo, Ustilago kolleri,Puccinia Graminis, Neurospora Sitophil and Mucor Mucedo*


Fertilization of A
Fertilization of a
Protoperithecium of mating type A
Protoperithecium of mating type a
Mycelium (N) of mating type A
Mycelium (N) of mating type a
Trichogyne
Protoperithecium
Conidia
Conidia
Ascus initial (enlarged)
Zygote (2N nucleus)
Ascospore germination
replication and first meiotic division 2N nuclei
Result of second meiotic division 1N nuclei
Ascospore germination
Ascospores from mitosis (N)
Ascus sac

(ii) Multiple Allelomorph or Multiple Allele Heterothallism:

In this type of heterothallism, more than two (multiple) alleles determine the sexual compatibility. These may be located at one (bipolar) or two (tetrapolar) loci.

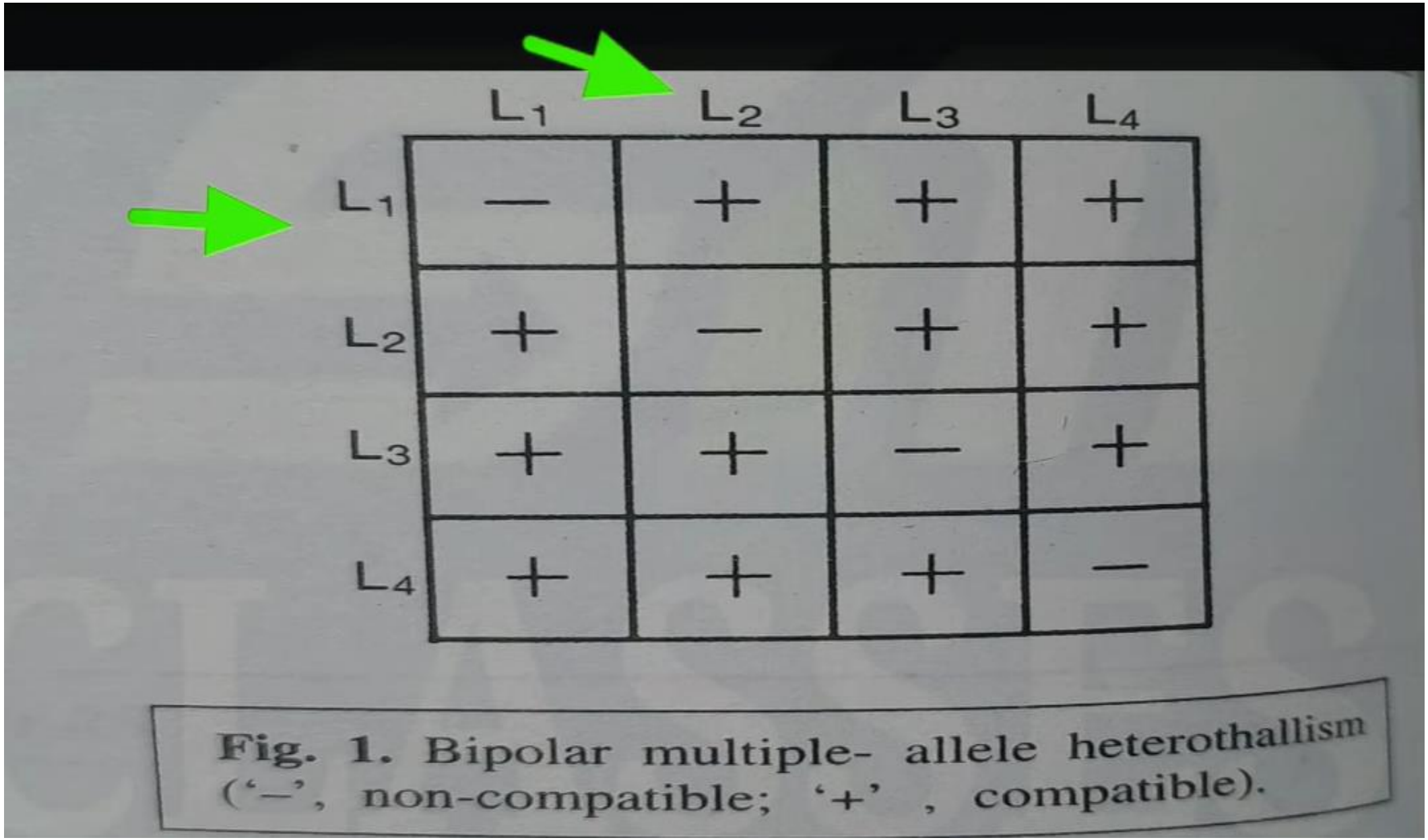
(a) Bipolar Multiple-allele heterothallism:

(b) Tetrapolar multiple-allele heterothallism:

(a) Bipolar Multiple-Allele Heterothallism:

This type of heterothallism is controlled by multiple alleles at a single locus, instead of a pair of Alleles. For example, if the locus is named as L, the multiples alleles will be designated as L_1, L_2, L_3, L_4—Ln and these are present on the single locus L.

The meiotic division will give rise .to thalli which may be of several mating types, generally equal to the number of alleles. The thallus containing the allele L_1 can mate with a thallus of any mating type except L_1.



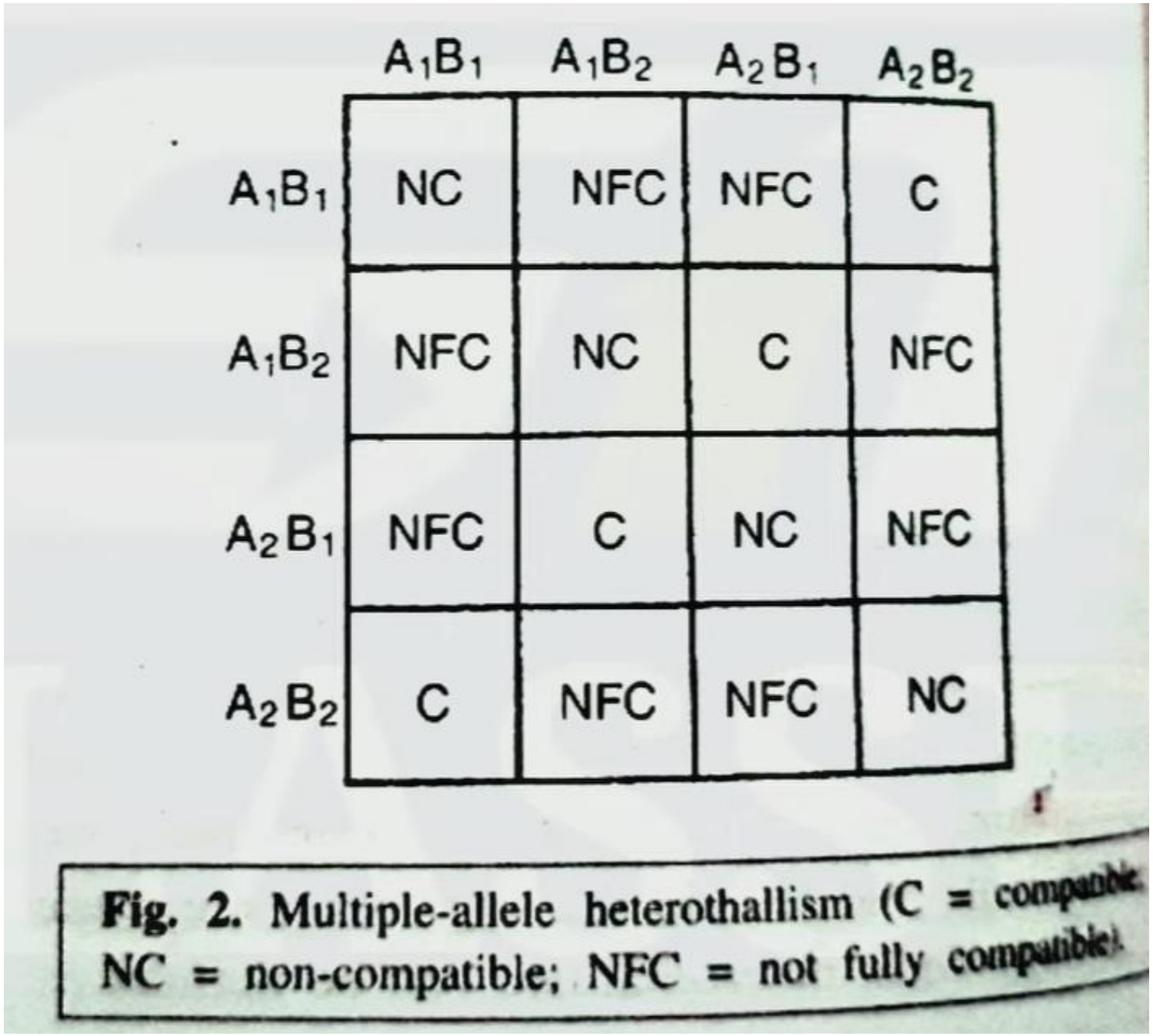
	L_1	L_2	L_3	L_4
L_1	–	+	+	+
L_2	+	–	+	+
L_3	+	+	–	+
L_4	+	+	+	–

Fig. 1. Bipolar multiple- allele heterothallism ('–', non-compatible; '+' , compatible).

(b) Tetrapolar Multiple Allele heterothallism:

This type of heterothallism is characteristic of Basidiomycetes except rusts. In this type of heterothallism, which is very similar to bipolar multiple allele heterothallism, compatibility is determined by two loci.

Multiple allele—the compatible factor is present on two loci L_1 and L_2 of two Chromatids of a chromosome. At the time of meiotic division, both the loci are separated with chromatids.



	A_1B_1	A_1B_2	A_2B_1	A_2B_2
A_1B_1	NC	NFC	NFC	C
A_1B_2	NFC	NC	C	NFC
A_2B_1	NFC	C	NC	NFC
A_2B_2	C	NFC	NFC	NC

Fig. 2. Multiple-allele heterothallism (C = compatible; NC = non-compatible; NFC = not fully compatible).

(ii) Multiple Allele Heterothallism:

(a) Bipolar Multiple-allele heterothallism: This heterothallism is controlled by multiple alleles at a single locus

Ex. *Coprinus comatus*

(b) Tetrapolar multiple-allele heterothallism: This heterothallism is controlled by multiple alleles at two loci

Ex. *Ustilago maydis*, *Comprinus firmaterius*

THANK YOU